Gold Seeking
in
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GOLD SEEKING

IN SOUTH AFRICA.

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GOLD SEEKING

IN SOUTH AFRICA:

A HANDBOOK OF HINTS FOR INTENDING EXPLORERS, PROSPECTORS, AND SETTLERS.

With a Chapter on the Agricultural Prospects of South Africa.

BY

THEO KASSNER,

MINE MANAGER, AUTHOR OF THE GEOLOGICAL SKETCH MAP OF THE DE KAAP GOLDFIELDS.

WITH MAPS AND ILLUSTRATIONS.

LONDON:
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PREFACE.

THIS little volume treats of the author's personal observations and experiences during his travels in South Africa. It makes no pretence at technicalities, its only object being to make clear and intelligible to the uninitiated all the necessary points in prospecting and mining, with other useful information, in the hope that it may be of service to those who intend to work in the country it deals with.

The endeavour has been to write in as simple, comprehensive, and concise a form as possible of the Gold-Bearing Strata of the Transvaal, and to help the reader by numerous illustrations and plans, so that he may follow with ease the detailed descriptions.

The main object the author had in view was to give information required by the individual who has decided to search for minerals and to develop his "finds" to such a stage that they may become "paying concerns" on either a large or small scale.

The author made a special study of these Goldfields and their reef formations during the years 1892 to 1900. In the introductory chapters is given a general description of the Rocks, followed by the main requirements of prospecting, descriptions of the various Goldfields, configurations of the several Reefs, as the author saw them, and his observations on them.

It is believed that if the reader comes across similar formations—in the districts described—he will recognise them, be enabled to judge of the value of the ground, and

be convinced that he need not abandon his search because of slight differences in details. It has also been deemed necessary to speak of the treatment of natives required for the work, to mention some precautions against fever, and to enumerate the chief requisites for exploration in wild parts.

Public interest in South Africa has greatly increased of late, owing to attention having been drawn to its great agricultural resources, its extraordinary mineral wealth, and its promising future, both politically and commercially.

The stranger is often in doubt what to undertake in this vast country, where the choice may be—for want of knowledge—a disappointing one, leading to misfortunes from which only persons of independent spirit can recover.

Alas! the many disappointments which usually overtake a stranger in an unknown land where the gold reports blind him are a great check in his life's career; therefore, in concluding this work, a more safe and steady undertaking is treated of—viz., Agriculture, regarded as the basis of all solid progress in a new country.

Splendid opportunities in this branch of industry are pointed out in describing the various parts of South Africa visited by the author.

LONDON, *May, 1902.*

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GOLD SEEKING IN SOUTH AFRICA.

CHAPTER I.

HISTORY OF THE SOUTH AFRICAN GOLDFIELDS.

DURING the last few years we have heard and learned much of Dark and Savage Africa; but the impressions formed of this far-off land are often vague and erroneous.

Periodical booms, resulting in grossly exaggerated ideas of the immense wealth existing there, and which the feverishly-excited public were led to believe could be obtained without much effort, have been quickly followed by the inevitable depreciation, alarming investors, checking exploration and progress, and bringing everything for a time to a standstill.

Owing to the overwhelming difficulties and the great hardships peculiar to the early days of travelling, the opening up of the interior progressed very slowly; but these drawbacks have by degrees been gradually and surely overcome, so that now it is quite possible to reach the richest goldfields in the world with comparative ease and even in luxury, by rail or steamship, fitted with every modern improvement and convenience.

The reports of the discovery of gold have very often led to the forming of hurried expeditions for the purpose of seeking the hidden treasure; but owing to a want of preparation, and to the insufficiency of equipment and requirements necessary, many of these too often ended in dismal failure. They were successful in disclosing vast wealth waiting to be realised; but the difficulties to be encountered were so great that the explorers were obliged to give up in despair and come away.

At first the native black tribes were the chief source of trouble, as, massing together in common cause to resent the intrusion of the white man upon their territory, no matter how peaceful his intentions, their opposition became very formidable indeed. This, added to the ravages caused by malarial fevers

(always to be met with wherever the soil is turned over for the first time), and the enormous cost of transport which the profit in gold mines did not cover, contributed to make progress very slow and arduous.

In spite of all drawbacks, however, the born traveller and determined explorer have not been discouraged, and many fresh discoveries have since been added to natural history, and the mysteries of hitherto unexplored lands have been revealed.

The ever watchful and hopeful investor is keen in recognising the value of such knowledge, and of turning it to profitable account. One sees to-day the result of his confidence and daring. With regard to the original discovery of the Witwatersrand Goldfields opinions differ.

Many contend that the honour is due to a Mr. Arnold, who found gold there in 1884, while others declare that it belongs to a Mr. Struben. So far as can be ascertained from South African history, gold was found in the years :—

1868. At Olifants River by Karl Mauch, also about the same time in Marico district (Malmani Goldfields, Plates I. and IX.).
1869. In the Sutherland Hills (Klein Letaba Goldfield) by E. Button.
1870. In the Murchison Range (Selatie Goldfields) by E. Button. A rush to these fields was made in 1888-1889.
1871. At Ersteling (Marabasstadt Goldfield) by E. Button. A rush was made here in 1872.
1871. At Mac-Mac and Spitz Kop. } Lydenburg Goldfield.
1873. At Pilgrims' Rest. } Lydenburg Goldfield.
1875. At Waterfall and Rotunda Creek. } Lydenburg Goldfield.
1875. At the De Kaap Valley, but not worked till the rush of 1882.
1881. In Swaziland by Mr. M'Lachlan.
1882. At Devil's Kantoor, ensuing in a boom.
1875-1882. At the Komati Goldfield, but only worked since 1885.
1884. At the Geldenhuis and Kromdrai Farms (Witwatersrand Goldfield), and about the same time gold was found near Heidelberg, Potchefstroom, and Klerksdorp.

There is ample evidence to show that the existence of gold was known in this country in ancient times. The ruins of Simbabi in Mashonaland are a proof of this. Much has been

To face p. 2.

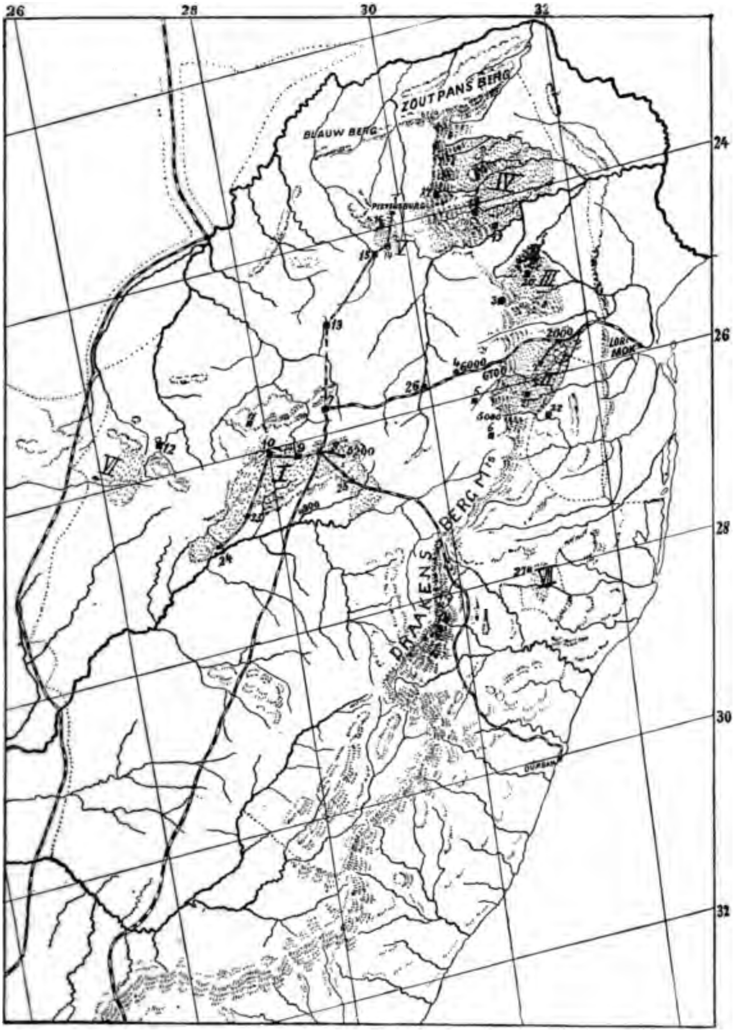


PLATE I.—GOLDFIELDS (as indicated by the dotted areas).

I. Witwatersrand. II. De Kaap. III. Lydenburg. IV. Zoutpansburg. V. Marabasstadt. VI. Malmani. VII. Vryheid.

written, and many years of study bestowed by able archæologists and explorers on this subject.*

In a country containing such possibilities there must often be disastrous results owing to unwise speculation.

These, in the main, are attributable to the short sightedness of investors, who purchase or peg out valueless ground, go to unnecessary expense in putting up costly machinery without having anything worth milling, and employ large staffs of officials and workers, thus creating a heavy charge upon their return before quite realising whether the choice of ground is worth it; on the other hand, valuable properties suffer much injustice.

There are many properties that would pay well, if economically worked on a small scale. This would help greatly towards the forming of a solid goldfield, and give many chances to enterprising men with limited means.

The towns are indicated in Plate I. by the following numbers:—1, Pietersburg; 2, Barberton; 3, Lydenburg; 4, Belfast; 5, Carolina; 6, Ermelo; 7, Pretoria; 8, Boksburg; 9, Johannesburg; 10, Krugersdorp; 11, Rustenburg; 12, Zeerust; 13, Warm Baths; 14, Ersteling; 15 Potgieters Rust; 16, Marabasstadt; 17, Houtboschberg; 18, Hænertsburg; 19, Selatie; 20, Pilgrim's Rest; 21, Steynsdorp; 22, Bremersdorp; 23, Potchefstroom; 24, Klerksdorp; 25, Heidelberg; 26, Middelburg; 27, Vryheid.

* *Ruins of Mashonaland*, by Theodore Bent.

CHAPTER II.

GEOLOGY.

To understand all organic life one must closely and analytically study everything that appertains to it. So it is with the construction and constitution of the earth; its rocks and strata, with their organic fossils and inorganic contents; the successive changes these have undergone, and their causes.

In studying the physical aspect of South Africa, a country which shows so many varying altitudes, mountains, valleys, and plateaus, one has every opportunity of learning the nature of its geological formation. South Africa, in general, is divided into what is locally termed the High and Low Countries. It rises from the coast towards the interior in a succession of terraces.

In the low land—which is usually very unhealthy—are found many well-watered plains, consisting mostly of various gravelly soils and rocks, often showing many alluvial deposits. In some of these deposits, which have been brought in the course of time by floods from great distances, valuable metals have been found. Any such discovery is an incentive to prospectors to follow the indication to its original source (Fig. 1).

Following the rivers up to their sources, through picturesque scenery, we find that the mountains have pointed, rounded, or flat-shaped summits, while long ranges slope terrace-like to the river banks; and rocky plateaus with deeply-cleft ravines and mighty precipices meet the eye. Many dykes of diorite and greenstone, run across and along these mountains, tilting the strata from horizontal to inclined and vertical positions. For miles the granite, which is the foundation of the sedimentary rocks, is exposed on the surface, in places rising to a height of over 5000 feet above the sea level. Coming to the High Country (locally called "High Veldt") we find a more recent formation overlying the rocks of an older period, broken by little spruits or streams, which form on their way to the Low Country, deep kloofs, picturesque waterfalls, and rivers.

The above-mentioned formations bear a great variety of precious and base metals; but the enormous quantity of gold discovered has put all other valuable and useful minerals in the background, with the solitary exception of diamonds.

These numerous gold-bearing strata, which extend over large areas, and which are exposed on the surface, are called "Goldfields."

It will be my endeavour in the succeeding chapters to confine myself to facts obtained through personal experience and investigations during my travels.

Classification of Strata and Situation of Goldfields.—The main divisions of the geological strata in South Africa, as given by Dr. Adolf Schenk, are as follows:—

1. South African Primary Formation.
2. Cape Formation.
3. Karoo Formation.
4. Recent Deposits.

The stratifications lie one above the other, the lowest naturally being the oldest.

The following paragraphs refer to the beds in the different goldfields only:—

1. South African Primary Formation.—This is the oldest and lowest formation. It is composed of granite, quartzitic slate, quartzitic sandstone, quartzite, hornblendic and chloritic schist, and is to be found in the following mining districts:—

Name of Goldfields.	Situation.	Principal Towns or Camps.	S. Lat.	E. Long.
			degs.	degs.
De Kaap (II.), . .	E. Transvaal	Barberton	24 to 26	30 to 32
Komati, ...	,,	Steynsdorp	26 ,, 27	30 ,, 32
Lydenburg, . .	N. Transvaal	Lydenburg	24 ,, 26	30 ,, 32
Selatie, ...	,,	Leydsdorp	22 ,, 24	30 ,, 32
Klein Letaba, . .	,,	Birthday Camp	22 ,, 24	30 ,, 32
Houtboschberg,. .	,,	Hænertsburg	22 ,, 24	28 ,, 30
Marabasstadt (V.), .	,,	Marabasstadt	22 ,, 24	28 ,, 30
From Johannesburg to Pretoria, . .	S. Transvaal	Pretoria	25 ,, 27	26 ,, 29

The Roman numerals refer to Plate I.

2. Cape Formation.—This overlies the primary, and consists of shales, sandstone, conglomerates, limestone (dolomite), and quartzite; it occurs in the following districts:—

Name of Goldfields.	Situation.	Principal Towns and Camps.	S. Lat.	E. Long.
			degs.	degs.
Witwatersrand (I.), .	S. Transvaal	Johannesburg	26 to 28	27 to 29
Heidelberg, . .	,,	Heidelberg	26 ,, 28	26 ,, 28
Klerksdorp, . .	,,	Klerksdorp	26 ,, 28	26 ,, 28
Malmani (VI.), . .	W. Transvaal	Ottoshope	25 ,, 26	25 ,, 27
Devil's Kantoor, (de Kaap). .	E. Transvaal	Kapsche	24 ,, 26	30 ,, 32
Lydenburg (III.), .	N. Transvaal	Lydenburg	25 ,, 26	30 ,, 32

3. Karoo Formation.—This lies, mostly in flat layers, above the others, and forms the High Country plateaus. It is known to consist of coarse whitish sandstone, blackish slate, and reddish sandstone, all of a soft nature.

The localities where this formation is found are very extensive. In many places thick coal-seams are found, and workings are in operation in the following places:—

Names of District of Coalfield.	Situation.	S. Lat.	E. Long.
		degs.	degs.
Wilgi River to Middelburg, .	S. Transvaal	25 to 26	29 to 30
Machadodorp to Belfast,. .	,,	25 ,, 26	30 ,, 31
Carolina to Ermelo, . . .	,,	26 ,, 27	30 ,, 31
Springs, ...	,,	26 ,, 27	28 ,, 30
Vereeniging, ...	,,	28 ,, 30	26 ,, 28
Cypherfontein, . . .	,,	27 ,, 28	26 ,, 28

Greenstone traverses all the above-mentioned formations.

4. The Recent Deposit.—This comprises all the alluvium washed from the surfaces of the older formations which have been exposed to the decomposing influence of the rapid and frequent changes which are so characteristic of the South African climate.

CHAPTER III.

PROSPECTING.

In prospecting it is important to search for places, where the lower strata is naturally, or artificially, exposed to the eye, and to get practical knowledge about the appearance of the formation.

After a time the eye, through constant observation, becomes so accustomed to the work, that it can generally identify formations even when seen from a distance. Prospecting is often a dangerous and difficult task, because some of the most important rocks are only exposed in deep kloofs or bushy country, while they are seldom found in those districts which are the most easily accessible.

Almost all dry river-beds, which in the rainy season have wild torrents, contain specimens indicative of the mineral deposits and geological formations occurring within the river basin.

By examining the large water-worn pebbles a general idea can be formed as to the places where the rocks they have been derived from are to be found *in situ*; the greater the wear, the farther have they travelled.

A prospector should search with as few tools as possible. Those which are necessary are:—

A map of the district.

A prospecting hammer, made for picking and hammering purposes.

A lens, for making minute examination of specimens.

A compass, for accurate bearings.

A clinometer, for measuring the dip of the strata.

An aneroid, for measuring height.

A note-book, for making notes of occurrences.

Sample bags to hold samples for analysing.

All these will go in a small bag or in one's coat pocket. On the other hand, in proving the "finds" one may come across, the following tools are necessary:—

Prospecting pan.
Pestle and mortar (steel).
Shovels.
Picks.
Windlass.
Water bags.
Forge.
Anvil.
Blacksmith's hammer.
Hammer for drilling (4 lbs.).
Saw.
Hatchet.
Rope.
Drills.
Dynamite.
Fuse.
Detonators.
Scrapers.
Candles or lamps.
Tent.

1. Alluvium (composed of materials deposited by water).—Some of the richest finds have been originally traced by following up the course of an alluvial deposit. In these deposits, such minerals are to be found as occur in the rocks and mineral veins of the country through which the depositing rivers have passed, such as gold, platinum, copper, tin ore, and many others.

Speaking of alluvial gold deposits, it must be understood that the discovery of such alluvial goldfields in the Transvaal and elsewhere has almost always been very disappointing to prospectors, as only a few of them have made profitable finds. Auriferous (or gold-bearing) alluvium generally occurs in small patches, so that, unless a rich pocket of collected gold be struck, the labour cost exceeds the value of the gold obtained.

On account of many exceptionally rich finds, large rushes were made to these fields, which led to the discovery of valuable mineral veins, and to the diggers and prospectors devoting their attention to the discovery of such veins. They soon saw the advantage in pegging out reef claims, knowing that they could sell them to speculators and investors for large sums of money at once. Hence very few now confine their efforts to alluvial digging. We have, however, no reason to condemn these alluvial fields, for they have not yet been exhaustively proved except in the case of thin layers which have been exposed by denudation.

This alluvium is of comparatively recent origin, washed from higher foundations to deep-lying plains.

New layers are formed after every flood, and the heaviest masses of gold find their way through the porous gravel to the bottom.

The gold-bearing deposit always settles in the quiet places below where flowing water runs over natural riffles, such as diorite dykes, which are harder than the associated rocks and therefore stand out higher in river-beds (Fig. 1), large boulders, and grass roots, as also in cracks or openings in the rocks.

The rock immediately below the alluvial wash is called "bed rock," and may consist of any of the rocks already mentioned.

The richest yield of gold is obtained just above the bed rock, generally in gravel, but sometimes in a gravelly clay or in clay, and in places where the current has been checked, especially on the outer side of sharp bends (see Fig. 2), where the heavy gold readily settles. The clay should be washed with great care (p. 10).

Fig. 1.—Auriferous alluvial deposits, resting against obstacles.—*a*, Schist; *b*, coarse gravel and soil, sparsely gold bearing; *c*, sand and clay containing the richest gold; *d*, diorite dyke.

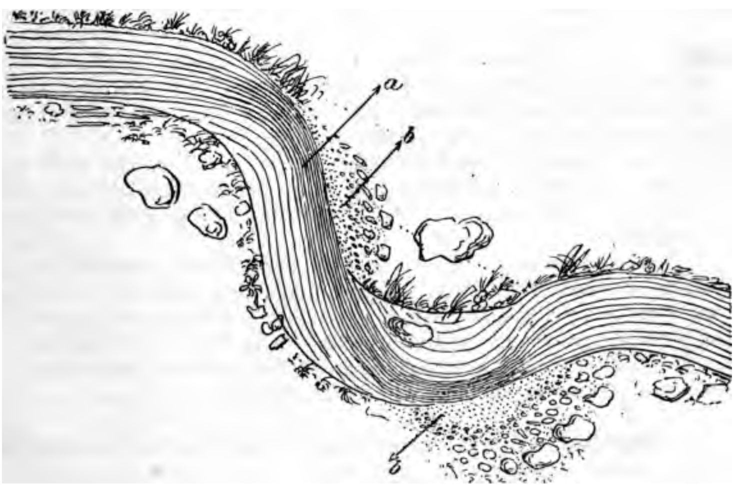


Fig. 2.—Deposits on river banks.—*a*, The current of water turned aside n two places; *b*, alluvial deposits in the bends of the river.

Large boulders of hard rock turn the water aside; but if the river flows over a soft formation, it eventually cuts its way through, and consequently the alluvial deposit remains undisturbed.

The fine alluvial gold dust travels farther down to the flat country, where the force of the water is not great; and it is found there amongst the sand on the banks of the river.

Again, alluvial deposits appear on terraces, on the sides of mountains, or on plateaus, where the more recent auriferous formation decomposes and is floated away, leaving the heavier particles behind.

Having found an alluvial patch, the principal thing is to ascertain whether the wash is sufficiently rich in quality and quantity to cover all expenses connected with transport, water courses, ducts, &c. Local circumstances have much to do with making it remunerative.

The porous nature of the gravel makes it easy to work with pick and shovel; but the large boulders usually met with increase expenses, as it is necessary to use dynamite for blasting them.

As before mentioned, one meets on the bed-rock gravel mixed with clay. Often, through ignorance of its soapy and sticky nature, much gold may be lost; for the lumps of clay, which do not disintegrate as quickly in water as the gravel, will be carried away with all their contents (see *Sluicing*). Therefore, in washing this particular compound, it should be rubbed between the hands, so that the clay runs away in the form of muddy water, and the heavy gold settles to the bottom.

The most easily-worked alluvial deposit is where the wash is shallow, and where generally a non-auriferous black surface soil overlies it. This must be first removed. The process is called "stripping."

When the payable deposit is laid bare, the work of sluicing can go on uninterruptedly. Again, deep-lying alluvial deposits are found where, in many cases, the stripping process is impossible to perform on account of the presence of hard overlying beds.

To reach it, shafts and drives must be used, and the payable ore brought to the surface, where the sluice-boxes are erected.

2. Proving Alluvial Deposits.—In testing the contents of the alluvial deposits, one generally employs the method of panning. Special prospecting pans are made for this purpose, stamped from a piece of sheet iron of a smoke-black colour, in order that the yellow gold may be more easily seen. By much use the smoky colour of the pan disappears, but can be renewed again by placing it over a fire, preferably over one made with brown paper as the fuel.

The pan itself generally measures 8 to 10 inches across the

bottom, and 12 to 14 at the top; it has grooves running round it, as shown in Fig. 3.

Fig. 3.—Prospecting pan.—The heavy metal accumulates in *a*, upper groove, and *b*, lower groove.

These grooves catch the heay gold, which sinks to the bottom, while all the lighter matter is washed away.

3. Panning.—In working, the following method is adopted:—Fill the pan about a quarter to one-half full with earth, the remainder with water, then stir the whole together with the hand. Pour half the muddy water very slowly away. Refill with water and repeat this process, using the while a sifting motion, by which the heavy substances settle to the bottom and the water becomes nearly clear.

When this point is reached, tilt the pan slightly and allow some of the light substance to flow out slowly with the running water. Continue refilling with clear water and pouring off, till nothing remains in the pan but the heavier metal. According to the results of the panning and the quantity of ore washed, experienced prospectors can judge very closely the value of the ground.

In panning alluvial deposits the large pebbles or stones should be removed after first carefully washing them in the pan, and the fine substance treated as described above.

It is advisable, for convenience sake, to have a tub or bucket close at hand in which to pan valuable deposits. Many mistakes are made by inexperienced men in filling the pan too full of earth. This makes the sifting process difficult to perform, and the gold, consequently, does not accumulate round the bottom of the pan, but is washed out with the other substances.

In panning, the gold is often noticed floating on the water; the reason of this is that the fine particles of gold are flat or covered with a soapy substance which formed its matrix.

By sprinkling it with water it will sink to the bottom.

4. Sluicing.—In treating large quantities of alluvial ore, one must resort to the more practical arrangement of sluicing in preference to the primitive form of panning.

For the purpose of ordinary field work, sluices are made in two parts, each consisting simply of three planks of wood, formed trough-like, through which runs a constant flow of water to wash away the sand, clay, or sediment (Fig. 4).

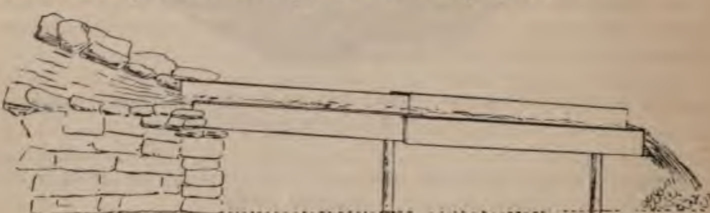


Fig. 4.—Trough-like sluice box.

The soil is shovelled into the higher end of the trough, and stirred if it is not carried away freely.

The nature of the gold is to sink, or to rest against obstacles; therefore, in the first part of the box, obstructions are made by long and cross bars of wood, with a sieve or screen at the lower end (Fig. 5, *a*) to catch all the heavier metal.

The fine gold dust will be carried farther; consequently the second box has appliances for catching it, arranged as follows:—Narrow cross bars (*c*), and at the end a rough blanket (*d*) (Fig. 5, *b*).

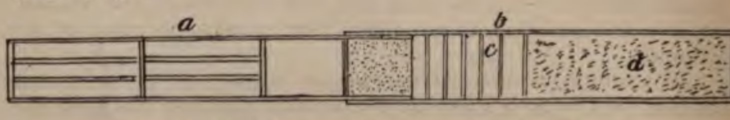


Fig. 5.—Obstacles on the bottom of the sluice box.

Many ways are adopted for arresting the gold, such as false bottoms; but this greatly depends on the individual and on the financial position of the prospector.

In any case it must be arranged that the box can be raised or lowered at one end, according to the nature of the earth washed, the usual slope being 8 inches in 12 feet (1 in 18). In washing soil containing fine gold, the sluices are made longer, and mercury is added, for the purpose of catching the gold, which blends with the mercury and forms "Amalgam."

The nuggets and fine gold are collected and cleaned in the pan. The amalgam is first cleaned in water, more mercury is then added, and the whole is squeezed through chamois leather.

By heating the amalgam the mercury evaporates and the gold appears as a spongy mass, called "Retorted gold" (see p. 26). The value of this can be ascertained by assaying and weighing.

5. Reef Prospecting.—As previously explained, veins are located by means of the signs in old river-beds, valleys, strata exposed in kloofs, creeks, or deep-cut waggon roads.

On finding loose pieces of ore-bearing rock, the first step is to search for the ore *in situ*. The clues for this abound, especially in a mountainous country, where ranges and long stretching outcrops attract the attention at once. The reefs exposed on the surface are called "Outcrops."

It is not to be expected that the outcrops of any reef will be equally manifest along its whole course, as it may be disturbed by variations in the dip, slips, by being pinched to nothing, or by being divided into many small leads ("leads," a term used to describe small strings of ore leading to the main body.)

Some are decomposed and are hence easily overlooked, while others occur as very large conspicuous outcrops with weathered and porous rock, looking like a melted mass of milky quartzite and reef matter. Then, again, outcrops appear running along and across the strike.

Faults will often divert the strike (*i.e.*, the direction of the outcrops of a stratum) to the right or left from its ordinary course. In their mineral contents also, many variations are found. It often happens that an outcrop contains gold in one place, and farther on none at all; but, on closer examination, sometimes one finds the gold in the casing ("casing" means the formation next to the usual gold-bearing body).

Often outcrops cannot be noticed, because they are entirely oxidised and appear to be red clay, though it carries the gold.

There are many reefs which bear no gold. In prospecting, it is advisable to take as little lumber as possible in the field, as the main object should be to examine as much ground as possible and to get a knowledge of the value of all the different outcrops.

The richest outcrops will naturally be dealt with in detail prospecting, in regard to its value in depth, which will be described later.

Prospecting of new ground should be done by walking, for to search properly one must climb and pass places where no roads nor thoroughfares are made.

In testing outcrops, one must be provided with a number of small canvas bags in which to gather the samples; these should be taken at every 5 feet along the strike of the exposed reef. Number the bags 1, 2, 3, and so forth. At the same time a sketch should be made of the situation of the ground, marking the reefs and spots whence the samples are obtained, so that the number on the bag will correspond with the sketch in the note-book. Afterwards take the various samples to the water, where a pestle and mortar (Fig. 6) should be used.

Fig. 6.—*a*, Pestle; *b*, mortar.

Fig. 7.—Gash vein.

Crush the different samples, one after the other, to a fine powder, and pass them through a fine sieve into the pan. Pan each sample in accordance with the number in the notebook, and write the result against it. When the results of any sample are favourable, it is important to return and examine those places more closely, and to collect further samples without picking or selecting any particular specimen.

It must especially be noticed if the lode (or reef) strikes across or along the strata. The former is of less value than the latter and is generally called a "Gash" vein (Fig. 7), because it usually ends in short depths tapering to nothing. They are very numerous in the auriferous fields and often contain good gold, as the gash veins are formed by reef matter filling fissures in the rocks.

On the other hand, the lode running along the strata is

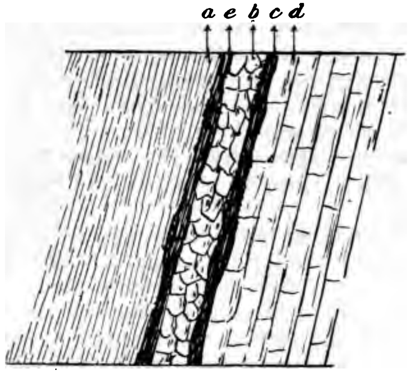


Fig. 8.—Fissure vein.—*a*, Schists; *b*, quartz reef; *c*, foot-wall; *d*, quartzite; *e*, hanging-wall.

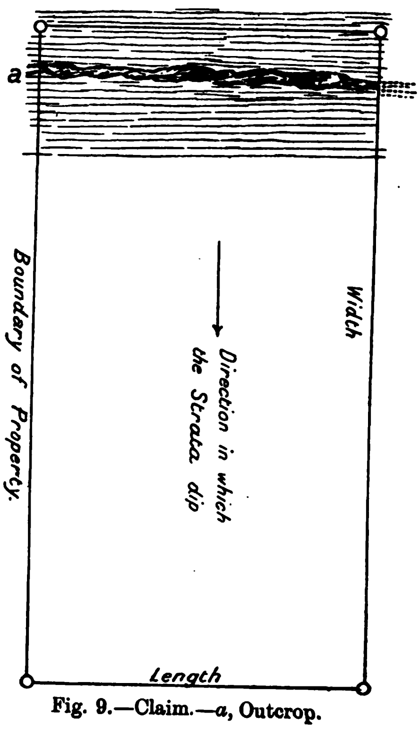


Fig. 9.—Claim.—*a*, Outcrop.

embedded in the formation, having a hanging- and a foot-wall ("hanging-wall" means the adjoining overlying strata, "foot-wall" the adjoining underlying strata, of the reef).

It runs with the strike and goes down with the dip of the strata and is called a "fissure" (Fig. 8).

Of course there are many drawbacks caused by irregularities in the strata which must be studied and taken into consideration.

To locate the boundaries of the ground selected, it is necessary to ascertain in what direction the strata in which the outcrop is bedded dips; then peg from the outcrop across the inclined strata in the direction of the dip, calling this the width of the property, and along the strata calling this the length, keeping the outcrop on the upper side, as shown in Fig. 9.

6. The Ground Work of Prospecting.—After having formed a satisfactory opinion as to the worth of the outcrops found, continue examination lower down. The work with the pick and shovel then begins.

Fig. 10.—A cutting across the formation.

Cuttings across the outcrop are usually made all along the strike, about 50 feet apart, each about 4 feet wide, 10 feet long, and 10 feet deep, in order to expose the reef (Fig. 10).

In many cases where the outcrop is only to be seen in small patches, it is advisable to make trenches along the strike of formation (Fig. 11).

If the result is not satisfactory, the best thing to do is to sink a shaft to about 30 feet, following the course of the reef wherever it dips, and drive below along the strike.

In places where the outcrops disappear, or where the reef is dislocated and faulted, a number of small trial cuttings or pits should be made, and thoroughly searched, special care being taken not to waste too much time on these, if there are better signs close by (Fig. 12). In all these various openings the aim should be to prove the actual nature of the reef, thus :—

(*a*) The hanging- and the foot-wall should be well defined.

(Sometimes it has a hard slaty appearance; at others, a soapy, slippery, or clayey one.)

(*b*) If there is no wall, ascertain if the country rock and reef unite or mix and gradually merge into the reef.

(*c*) Ascertain the width of the reef; if it is solid, decomposed, or honeycombed; if in layers or in blocks; if mixed with sandy or schisty matter; if divided or in one lode; if rich or poor; if patchy or equal; if it consist of quartz or conglomerate, and what colour; if it contains large or small pebbles, and how these are bound together.

(*d*) The reef-matter should be sampled equally and frequently, while working.

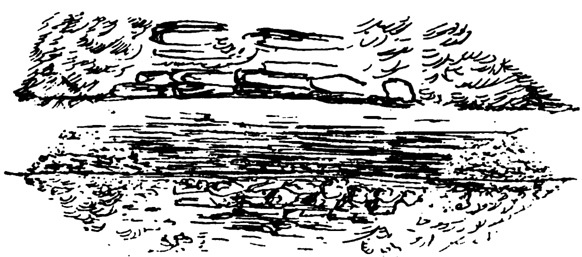


Fig. 11.—A trench along the formation.

Fig. 12.—Disturbed formation where much work should not be done.

Sample No. I.—Break off small pieces from every part of the exposed rock, and collect specimens of the decomposed matter, if any.

Sample No. II. is to be taken from the foot-wall.

Sample No. III. is to be taken from the hanging-wall.

Sample No. IV. is formed of specimens collected along the whole length or strike exposed.

All these must be panned; this will give a fair idea as to how much gold could be produced. From time to time samples may be taken for assaying by heat, but it is wise to have this done by a responsible person.

(*e*) Ascertain the nature of the "casing" or "country." Is it quartzite, sandstone, slate, schist, or a mixture? Does it carry gold? or are there any aqueous rocks near by?

(*f*) The dip must be measured in the direction of the strike, at a right angle to the horizon. This will give an estimate of the quantity of ore within the boundaries of the property.

A vertical lode will have a large deep dip, and a flat one will soon run out of the ground.

An accurate dip can be measured with a clinometer. In the goldfields where a lot of old workings, shafts, drives, and ruins of buildings are noticed, it is always wise to make thorough examination there, as no one knows the circumstances under which these were left. The prospector will meet with many occurrences in formations and reefs, which are very often puzzling; therefore he must bring his whole mind to consider how these natural causes are effected. After all the necessary details of the tracing and proving of lodes on the surface have been obtained, further developments must proceed in the sinking of shafts or driving of tunnels wherever it may be necessary.

Shafts should be put down following the reef all the way, as otherwise the trace of it may be lost. These are made to ascertain the value of the reef in depth.

They should be made large enough for the safe passage of workmen, without interrupting the constant work. Supposing the reef is struck at a depth of about 50 to 80 feet, the process of driving along the strike should be adopted in order to expose the ore in length, so as to estimate the quantity and quality. When the drive is continued for some distance, the air becomes foul, and it is necessary to sink a second shaft in communication with the first so as to establish a free current of air (Fig. 13).

Small shafts sunk for the purpose of ventilation from one drive (or adit) to another are called *winzes*. The adits and winzes should, if possible, expose the ore, so that it can be mined from all sides. The excavating of this space is called *stoping*; if the work is carried on from below upwards, it is called *overhead stoping*; if from above downwards, *underhand stoping*. The latter is usually preferred, as the foul air often collects in the overhead stopes, and work is more difficult, consequently more costly to perform.

It is advisable to leave pillars of rock in such stopes for the

safety of the mine; or if the side walls are fairly solid, timber may be used instead.

After all the valuable ore has been secured, the stope can often be advantageously packed firmly with hard waste rock, in which case the timber can be used over again.

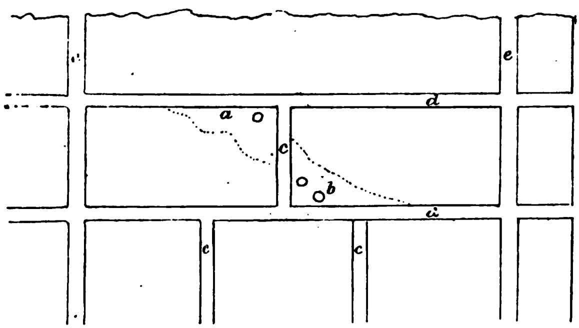


Fig. 13.—Laying out underground developments.—*a*, Underhand stope; *b*, overhead stope; *c*, winze; *d*, drive or adit; *e*, shafts.

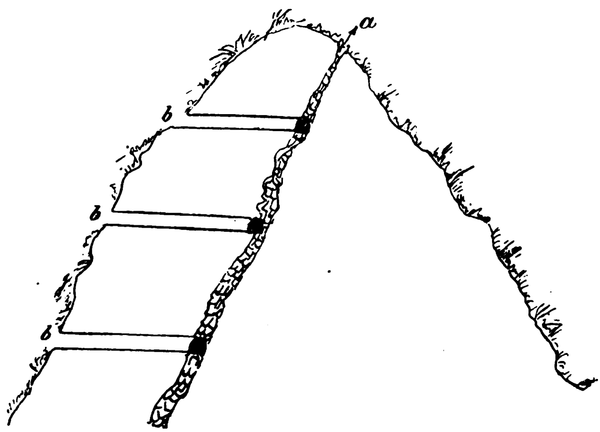


Fig. 14.—Development on a mountain side.—*a*, Outcrop; *b*, adits.

When mining on a large scale, extra working shafts and adits are usually established for the free passage of ore to the surface. The shafts are then more closely timbered than is usual for ordinary prospecting purposes; this work is carried out by experienced carpenters.

Of course, there are many methods of shaft sinking which depend greatly on the situation of the property. In places it is preferable to sink along the dip of the reef, and in others vertical shafts are sunk through a great amount of dead rock to meet the reef.

Hauling and pumping machinery, compressed air, and machine drills are used when sinking at greater depths. Otherwise, in the starting and working of smaller concerns, the primitive way of bringing the ore and water in buckets to the surface by means of a windlass, and, later on, small machinery, is adopted.

If the reef crops out on a steep mountain, and dips with the slope of the same, or is exposed on the face of the mountain, the cheapest way will be to drive to meet it, or along the strike (Fig. 14).

For any further deep mining, hauling and pumping will be necessary, in which, of course, different methods from those of general prospecting are adopted.

7. Timbering.—In the event of any prospectings becoming dangerous, through cracks, decomposition, boulders, or water, timbering is necessary. This, of course, depends on the extent

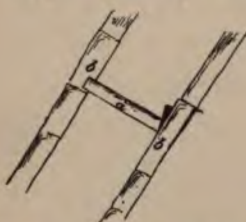


Fig. 15.—Wedged timber. *a*, Timber; *b*, loose rock.

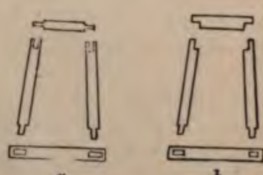


Fig. 16.—Sets of timber.

of the danger. In solitary places, where a piece of rock hangs loose, by which the other rocks are not affected, a simple means of support is a piece of timber wedged firmly against it (Fig. 15). In places where a drive or shaft is very shaky, a complete set of timbering must be made, which can be fitted, screwed, or wedged together (Fig. 16).

Behind two sets of timber long poles should be horizontally fixed above, and placed on both sides of the tunnel or drive, so that the space between the timber and the tunnel wall can be firmly packed with debris. This prevents little stones from falling out from time to time, making room for large heavy slips,

To face p. 20.

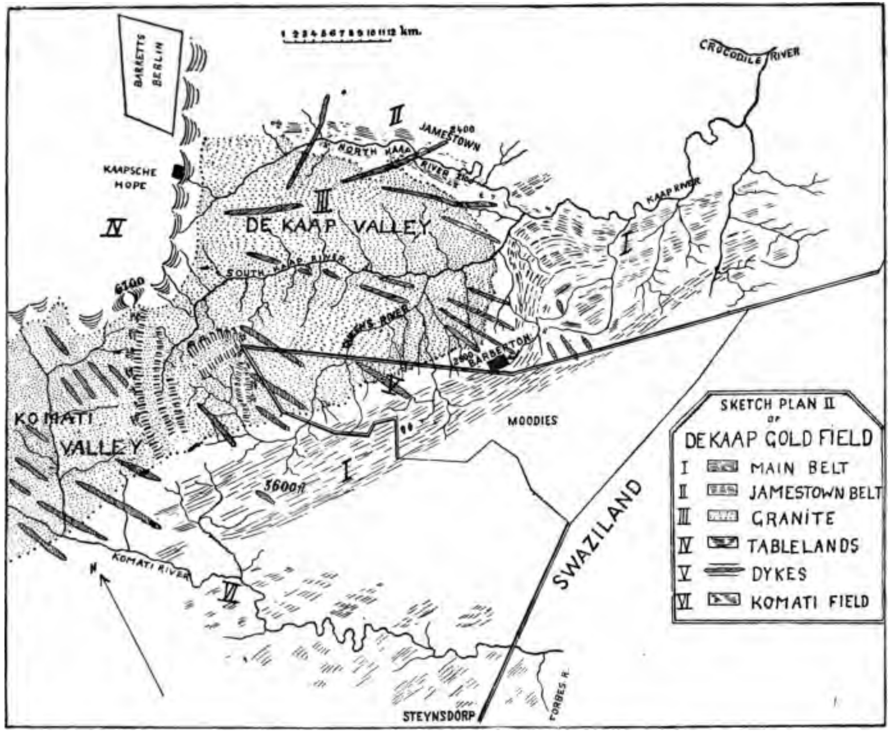


PLATE II.

which would in many cases break the frame work (Fig. 17). In the same way shafts may be timbered, and the sets only logged, as in Fig. 18, but great care should be taken to wedge the sides very firmly, so that nothing can fall on men working below.


Fig. 17.—Framework of a drive.

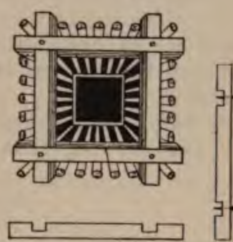


Fig. 18.—Shaft timbered.

In making shafts during prospecting, windlasses and buckets are needed to bring the material to the surface. The framework should be 4 feet by 6 feet, and be made of timber well fitted together (Fig. 19).

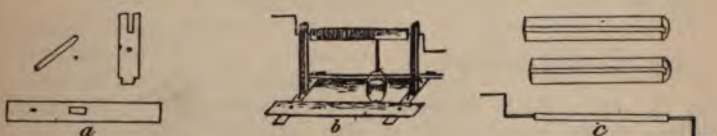


Fig. 19.—*a* and *c* show the manner of preparing ; *b*, framework of windlasses.

The drum should be cut in half, lengthways, an iron bar fitted in the middle, and the two parts well screwed together as in Fig. 19, *c*.

The rope should be well fastened with nails at one end, or serious accidents may happen by the bucket dropping down when the work is proceeding.

8. Blasting and Drilling.—Experience in blasting and drilling is most important, as the amount of work done depends very much on this. The steel drills should be made round, not too pointed, but sharp (Fig. 20), and hardened according to the nature of the rock. The hole which is to be made should be

placed at a spot where no fractures can be seen, as the explosives are not effective in broken rock owing to small pieces being blown out, without moving the bulk of the rock. The drill should be held steadily at the chosen place, and, at every blow of the hammer, rotated, so that the hole keeps perfectly circular, and the jamming of drills is avoided. If the hole is kept constantly wet by pouring in water, the work proceeds much more quickly. The mud accumulated during boring is removed by a thin piece of iron, with a small disc at one end, called a *scraper;* on valuable ground it is advisable to test this mud for its contents.

After the hole is finished the dynamite necessary (usually one or two cartridges) is tightly rammed to the bottom by a wooden stick; there is danger in using an iron rod.

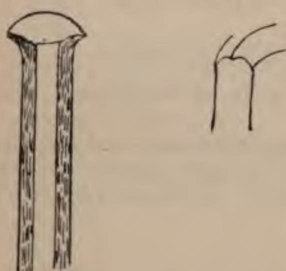


Fig. 20.—Drill sharpened.

The detonator, in which the fuse has already been fixed, is carefully pushed into a half cartridge of dynamite. The whole is then placed gently on the top of the other cartridges already in the hole, which is then filled up tightly with fine soil, pressed in with a wooden stick.

To more readily apply light at the end of the fuse, a small slit is made and a little dynamite placed in it. One should be thoroughly acquainted with the length of the fuse required, so as to gain sufficient time to retreat to a safe place before the explosion. In wet places the contiguous ends of the detonator and fuse should be greased in order to prevent water from getting in between them, and the holes filled with water tamping.

In the case of an unexploded charge, which is mostly caused by a bad fuse not burning to the end, one should in no case visit the place again under thirty minutes; it is therefore wise to blast during the meal hours. It is important to count the number of charges, when exploding.

The best way with unexploded charges would be either to remove the tamping carefully and place a new charge on the top of it, or to drill another hole close by, but taking care not to bore into the former. Accidents arise chiefly through carelessness.

It is also important to know how to place the drill holes, so that the explosives may exercise their utmost power.

If the holes are made in the direction of the joints or of the slope of the strata, the explosives do not blast so much rock as when made in a transverse direction thereto (Fig. 21).

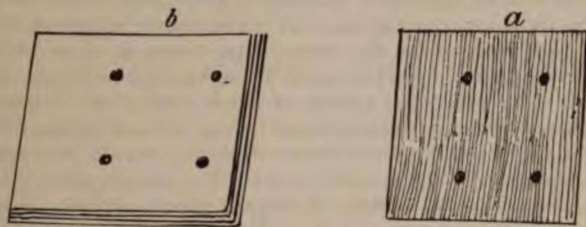


Fig. 21.—Drill holes.—*a*, Directed with the strata; *b*, directed across the strata.

To put much explosive in a drill hole in order to create a big effect is unwise; as a smaller quantity, in accordance with the size of the hole, will do as much work. It is only a waste of dynamite and money. Blasting should not be resorted to where pick and shovel can do the work.

9. Facilities of Working.—It is well to make sure that the facilities of working are favourable before incurring much expense; the following considerations, therefore, should be borne in mind:—

1. Is there any wood on the property, or close at hand and at reasonable price, or must it be imported?
2. Is black labour plentiful, or only to be obtained from distant kraals, and under what conditions?
3. Must a stamp battery be worked by water or steam power, and can it be easily set up on a suitable spot?
4. Is the transport of material and provisions costly, and what is the rate of such transport? At the same time little mining work should be done until the value of the reef has been satisfactorily proved. Also one should be cautious in starting operations, even after satisfactory trials have been made, as much harm is done to good properties by unsuitable or unnecessary work, owing to waste of money and of time; and to the consequent lowered reputation and yield of the property.

Although I will not go into the details of the construction of batteries and special machinery, I think it necessary to explain the most important points.

Before any battery work or erections are proceeded with for

the purpose of extracting the minerals, it is most necessary to have a quantity of ore dumped, or in sight, so that the crushing of the rock will not be delayed.

Ore should be regularly excavated while the former is being used up, in order to keep the mill continuously supplied.

The gold present in the rock in the form of dust or small grains is separated by grinding or stamping the rock (previously reduced, if necessary, to pieces of convenient size by means of the hammer or stonebreakers) to a fine powder, the latter operation being effected by rapid blows of heavy stamps actuated by steam, water, or other motive power. The fine powder obtained is transferred to a stream of water, which carries away the lighter material and allows the heavier gold to be passed over quicksilver, by which it is retained.

The amount of ore crushed depends on the drop and weight of the stamps, the size of the screen, and the nature of the ore. A heavy stamp has the advantage of crushing hard quartz rock. Self-feeders are useful, as they regulate the quantity of ore passing to the stamps from the back. Five stamps of equal weights are fixed in a substantial iron mortar, the usual weight being from 750 lbs. to 850 lbs.

The stamp consists of a rod which fits into a heavy head, the lower end of which receives the socket of a mass of metal called the *shoe*; this shoe impinges upon the *die* placed at the bottom of the mortar. The shoe and the die are the wearing parts, and are therefore made to be removable, so as to allow of either being renewed when worn out.

A sieve is placed in front of the opening of the mortar, and through it all the fine powder is sifted on to a slightly slanting table with amalgamated copper-plates, on which the gold unites with the quicksilver. Any pyrites or fine gold that escapes is caught by different sluices with blankets and concentrators, from which the gold is extracted by special treatment.

The water which carries the powdered ore over these various arrangements passes through an iron pipe at a regulated speed of about ½ to 1 cubic foot per minute, and flows into the mortar box.

The action of the stamps splashes the muddy fluid in the mortar against the screen, which gives passage only to the particles which are smaller than the holes in the screen, which particles flow with the water on to the large copper-plates in front. Clayey or soapy ore requires more water than the sandy pulverised kind.

The great bulk of the gold should be caught in the mortar.

For that purpose copper plate-linings are fixed in the mortar. The copper-plates are dressed with quicksilver, which is absorbed by them after several hours' hard scrubbing with a brush till the surface shines brightly. Much gold is lost if the plates are not sufficiently covered with a thin coating of gold amalgam, as the gold clings more readily to amalgam than to quicksilver alone. Badly amalgamated plates will show dark coppery spaces where dressing has been unevenly applied. Heavy iron tools should not be thrown on to the plates, as holes are easily made.

In preparing the plates the following process is recommended, though it must be understood that detailed improvements can be gained by experience, and also that there are many other processes used by skilled amalgamators, all more or less serviceable.

First, the copper-plates should be cleaned by covering them with fine sand, then scrubbed with a brush or with small blocks of wood until the bright copper is exposed. Caustic soda may be used to remove any oily substance. A cyanide of potassium solution (1 ounce of the potassium salt to 2 pints of water) should afterwards be brushed over the surface.

In order to amalgamate the quicksilver with the copper sheet, sal ammoniac and fine sand, in conjunction with quicksilver, should be scrubbed all over the plate, and the surface of the latter sprinkled over from time to time. This must be continued for several hours, until the plate has absorbed sufficient quicksilver to allow of milling being commenced. It is a great advantage to rub some amalgam over the dressing, as this prevents the loss of gold mentioned above when starting. The cyanide of potassium solution should again be applied, as it preserves the brightness of the plates. During the operation of milling as much quicksilver as the plates will take up should be applied about every two hours. The superfluous quicksilver will run off in drops.

Sal ammoniac and cyanide of potassium should also be wiped over the surface at intervals to keep it clean; care must be taken that no oily substance falls on the plates, for this will prevent the gold from adhering to the amalgam. The cleaning of the battery is usually done every eight days.

The amalgam forms a layer over the copper-plate, which grows thicker according to the richness of ore passing over it, forming in course of time a very hard crust.

Most of the gold amalgam is collected in the mortar box, and the cleaning process consists of taking out the dies, starting with

the corner one and lifting it out with a crowbar. The lumps of amalgam must be collected from around the dies and linings, and the sand then cleansed in the sluice boxes. In it will often be found a proportion of iron chipped off the stamps and dies, which must be removed by means of a magnet.

The plates on the table have most amalgam near the screens. The larger portion of the amalgam should be removed every day when rich ore has been crushed. By means of a chisel the amalgam covering is freed from the plates, but care must be taken not to expose the copper.

A dressing of quicksilver is added in the same manner as during the milling process after cleaning. After collecting all the amalgam from the mortar, plates, and sluices, the lumps are broken fine and cleaned in quicksilver, a small mortar being used for this purpose. The dirt and base metals, as copper, iron, pyrites, and lead, will float on the top, and should be removed by a piece of cloth. The gold amalgam always settles at the bottom.

The cleansed amalgam is squeezed through a piece of canvas, which allows the quicksilver to ooze through, so that what remains is a compact ball of gold amalgam. The filtered quicksilver can then be used over again.

The next thing will be to separate the gold from the quicksilver, which is called *retorting*. The retort apparatus consists of a cast-iron cylinder or pipe (according to construction), closed at one end, and of the size required. A cover must be firmly screwed on the other end to make it air-tight. A tube in the middle pointing upwards allows the quicksilver fumes to pass over into a vessel of water (Fig. 22).

Fig. 22.—Primitive retort. —*a*, Iron pipe; *b*, tube for connection with a vessel containing water.

The amalgam is placed in the retort, which, when made air-tight, is subjected to a heat not too fierce for about two hours. This completes the process. The retorted gold has a dull yellow appearance, and a very porous texture, indicating the spaces which the quicksilver previously occupied. In melting the bullion, plumbago crucibles are used.

The furnace is heated with charcoal. The principal chemicals for melting (fluxes) are usually borax, saltpetre, carbonate of soda, and sand.

CHAPTER IV.

THE DE KAAP GOLDFIELDS.

(PRIMARY FORMATION.)

THE information in the preceding chapters will enable the reader to follow with more interest the occurrences and appearances in the goldfields now to be dealt with.

In this goldfield we find a low region called the "De Kaap Valley," forming a basin surrounded by high mountains. This basin is about 2800 feet above sea level, lies immediately to the north of Barberton (the principal town of the field), and consists chiefly of granite.

South of the granite basin the sedimentary strata form a range of mountains, some of which rise to 5500 feet above the sea level. Deep kloofs, overgrown with luxuriant foliage, and watered by swift-running streams, which seek a way past big boulders, disappear, and then re-appear in rushing torrents, or tumble wildly over rocky precipices, divide and cut the range into rugged, conical mountains (Fig. 23).

On both sides of the creeks and streams the steep rocky walls of the mountains show clearly the stratification of the sedimentary formation with its enclosed reef. They generally have a dip of 50° to 75° to the south, but are vertical in places. These terrace-like ranges of hills form a distant line, which winds snake-like in long sweeping curves in an easterly, and sometimes northerly or southerly, direction, with the granite always under it.

This reef contains important gold veins, for which reason it is called the "Main Gold Belt of the De Kaap Valley" (see sketch plan of De Kaap Goldfield, Plate II.).

On the east of the valley another line of formation runs from the north-west to the south-east, and is called the "Jamestown Belt" (Plate II., plan), after the well-known alluvial diggers' camp in Jamestown about 2200 feet above sea level.

The prominent features of this range are broken, low, chain-like kopjes, between which the north Kaap river picturesquely

Fig. 23.—Range of mountains called the Main Belt.

Fig. 24.—Table-lands.—A mountain north of Barberton called "Tafelkop" (6700 feet high), with flat-lying sandstone and conglomerate beds, underlaid by shale formation, and in places by granite.

flows. Numerous auriferous reefs exist here. Towards the north this formation disappears under the flat-lying sandstone or table-lands of the Devil's Kantoor (a well-known alluvial district). In the east it joins the main belt and runs along with it.*

These table-lands, with an elevation of from 5500 feet to 6700 feet, form the northern boundary of the valley, and lie about 20 miles north of Barberton (Fig. 24).

Rising sharply from the valley, the bold and rugged outlines of these mountains, with their wild and treacherous-looking precipices, are clearly defined against the sky. The upheaved granite, represented on the slopes by large boulders, supports a much disturbed schist formation, and this in turn is overlaid by flat, thick sandstone, forming the table-like mountain tops.

Conglomerate reefs are found here. These table-lands [illegible] for many miles westwards, and these pass into the [illegible] the High Veldt. On the slopes of these mount[illegible] seen the heaps of debris from old alluvial work[illegible] the rush in 1882. On the west of the valley [illegible] worn into mountains of a peculiarly beautiful fo[illegible] height of 4000 feet above sea level, and divides [illegible] Valley from the Komati Valley, which latter st[illegible] west towards the High Veldt Plateaus (se[illegible] Plate II.).

The De Kaap Valley is itself broken here [illegible]ere by hillocks of granite boulders and by diorite dykes, which, running from north to south, athwart the sedimentary formation, give rise to the winding course of the Main Belt. Although the granite breaks and disturbs the strata nearest to it, it has had only a slight effect on those farther away. This shows that the pressure from below could not have been very strong.

The Queen's river (or South Kaap river) and the North Kaap river (or Lampogravana) run through the whole of the valley, both having their sources in the mountains to the west.

In the east these two rivers meet at a place called "Junction" and run further as the "Kaap river" into the Crocodile river near Komati Poort, which empties itself near Lourenço Marques into the Indian Ocean.

In the rainy season all the creeks and streams become swollen and rush wildly down the high mountains, bringing all the

* The geological sketch map of De Kaap Goldfields, by Theo. Kassner, shows clearly the junction of the two Belts.

oxidised or decomposed surface crust of rocks, &c., down to the valley, forming fruitful agricultural soil.

In many of these creeks on the banks of the rivers and spruits near Barberton, below the Devil's Kantoor and Jamestown, much alluvial gold has been found.

It is quite possible owing to the favourable situation of the valley, surrounded as it is by these auriferous mountains all sloping towards it, that in the lower parts much gold alluvial rests on the bedrock, and no doubt many surprises await the energetic digger in the future.

1. Barberton.—This town (which is shown in the frontispiece) is situated in the valley, just below the main belt, about 2800 feet above sea level, and is connected with the Barberton Kap Muden Railway, a branch of the Pretoria and Delagoa Bay line. It takes its name from a man named Barber who found a [illegible] Creek, just behind the town. It has to-day a [illegible] we can see from the few solid [illegible] that much activity and life existed [illegible] the summer months, called the [illegible] evenings succeed the intense [illegible] storms occur, which, owing to the [illegible] ntains, are very fierce and sudden. [illegible] pleasant, and breezy (see *Climate*). The [illegible] ry healthy, even in the summer season.

As above described, the De Kaap Goldfields are divided into four separate auriferous groups, and these are :—

1. The Main Line or Belt.
2. The Jamestown Belt.
3. The Granite Basin or Valley.
4. The Table-lands or Conglomerate Beds.

I will now proceed to describe their reef and alluvial phenomena.

2. The Main Belt (described as "Silurian Beds" by H. Penning).—The many combined, wide stretching strata, in this belt, as mentioned before, run in a very changeable strike.

From Barberton they bend and run direct north, with an easterly dip, and swing round in a deep curve at Junction, in union with the Jamestown belt, to the east, with a southerly dip, and are traceable in parts almost to Komati Poort.

To the west, from Barberton, they run through Moodies concession farm in a westerly direction, and strike off to the north

in the Weltevreden farm, from which it turns towards the Bellevue farm in a westerly direction again till they disappear in the south-west of a place called Warm Baths in the Komati Valley. All along this line the gold-bearing lodes can be followed, and are exposed in many places on the surface; but little work has been done owing to the many difficulties to be overcome in a mountainous country, and the discouragement of prospectors by the few investors (compared with the vast extent of the field) who were attracted elsewhere.

The auriferous veins contained in the belt can be arranged in about four principal lines, which are, in many cases, in the west different in nature from those in the east.

The general formation consists of quartzitic sandstone, talcose schist, and chlorite schist, in which quartz and quartzite are interbedded. Greenstone and diorite dykes often strike across or are interbedded and run parallel with the stratification, so that in places the formation is much disturbed. The veins occurring close to it are generally rich in gold, but very difficult and expensive to mine on account of this disturbance. The oxidised crust often has a depth of some hundred feet, owing to the heavy rains and the many sudden atmospheric changes usual in hot climates.

The gold occurs here in milky-white, light-grey, blue-grey, yellow, reddish, and even black-coloured quartz.

On the southern boundary, forming the highest range on the main belt, a very characteristic band occurs, and two wide conglomerate beds are exposed, running parallel with each other (Fig. 25).

They are bedded in sandstone formation, and are traceable from the Komati Valley in the west, eastwards to the Montrose farm, where it disappears in places, but re-appears again regularly on Moodies concession, running past Barberton to the south-west of the Sheba mine.

Beyond this it can be seen in places on the ranges towards Komati Poort (6 miles distant from Malalane Station).

This forms the strongest formation on the south of the gold-bearing strata of the main belt, which runs parallel with it, keeping always on the north side. Each conglomerate bed is about 20 feet wide and has an average dip of about 75°.

Between the beds the formation is sandstone, about 100 feet in width. The conglomerate consists of flinty and quartzite pebbles of large size and angular forms, cemented together with fine-grained sandstone and talcose schist. It contains in some places from 2 to 4 dwts. of free gold, with a little pyrites; but

it has not been much prospected and explored. Turning to the north and passing over sandstone and schist formation, which is 1000 yards or more in width, the first line of the reef is met with, and is exposed and opened up here and there for many miles. The lode varies from 2 feet to 15 feet in width, and dips generally with the strata at an angle of from 52° to 75°.

The outcrops are often very large ones, but rarely alike. They form large, milky, dull-looking quartzite bodies intermixed with blue-grey quartz, are very brittle, and contain fine-grained gold. Others are much honeycombed with visible gold and sulphide of iron and arsenical pyrites in the cells. It is so decomposed that, on the surface, it gives a look like old melted

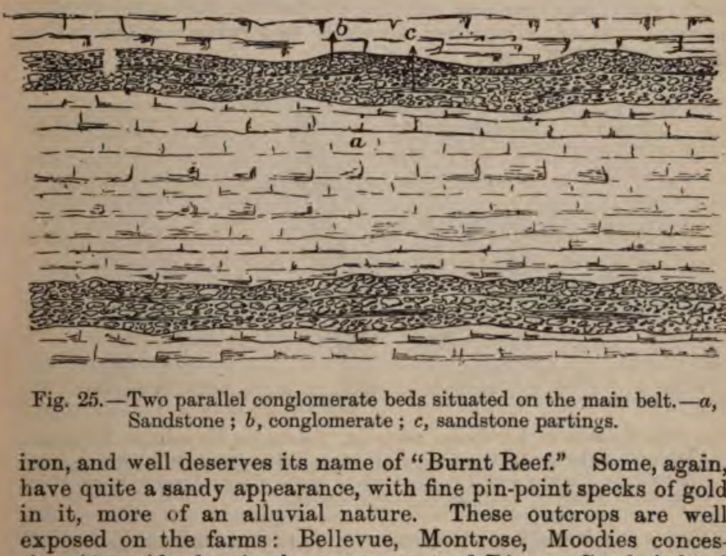


Fig. 25.—Two parallel conglomerate beds situated on the main belt.—*a*, Sandstone ; *b*, conglomerate ; *c*, sandstone partings.

iron, and well deserves its name of "Burnt Reef." Some, again, have quite a sandy appearance, with fine pin-point specks of gold in it, more of an alluvial nature. These outcrops are well exposed on the farms: Bellevue, Montrose, Moodies concession (Armside farm), the upper part of Rimers Creek behind Barberton, and on the Sheba Hill, the above-mentioned conglomerate always keeping to the south of them.*

The decomposed crust of this band is generally very prominent; it contains antimony ore in places, but only near the surface.

The reef matter itself varies in appearance according to the

* This conglomerate is distinctly shown in the geological sketch "Map of de Kaap" by Th. Kassner, 1899.

depth reached, say from 50 to 100 feet; sometimes as blue-grey looking quartz blocks (Fig. 26, *d*), in which the crystals of quartz reflect many beautiful colours, owing to the clay and pyrites pressed out in their cleavage planes, and sometimes conglomerate-like and very brittle, containing coarse gold, which on the foot-wall is very rich. In this case, generally a 10 to a 15-feet wide body of very decayed quartzite, quartz and clay mixed (worth only from 2 to 4 dwts. per ton), occurs next to it, having about 2 feet of schist. The same body, when solid, is quartzite, alternating with chlorite schist.

The foot- and hanging-walls in the undisturbed formation are well defined here. A peculiarity met with next to the foot-wall is a distinct black and white striped formation composed of thin, black, slaty, hard-pressed laminæ, alternating with a white thin seam of quartz, altogether about 2 feet wide, called "The Ribbon Bar" (Fig. 26).

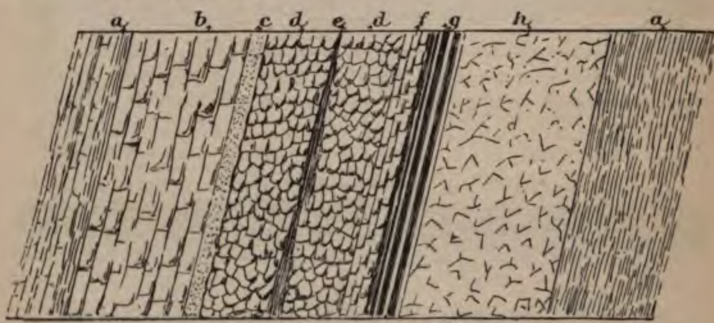


Fig. 26.—Section of auriferous reef.—*a*, Sandstone or schist; *b*, quartzite and chlorite schists; *c*, clay seam intermixed with fine quartz pieces; *d*, quartz reef; *e*, division of dark slate; *f*, quartz layers on the foot-wall; *g*, "ribbon bar"; *h*, diorite.

These black slaty laminæ are very pyritical, and often regular layers of cubical pyrites are found. In other places only a slaty formation composes the casing on the foot-wall. Next to this a hard diorite dyke or blue-bar accompanies the lode, having a width of about 50 feet (Fig. 26, *h*). Adjoining is chlorite schist or sandstone (Fig. 26, *a*).

On the hanging-wall a clay seam 1 foot thick, intermixed with fine pieces of quartz, both gold-bearing, is generally noticed (Fig. 26, *c*), next to which is the quartzite and chlorite schist formation (Fig. 26, *b*). In driving along the strike of this

reef at a deep level, many difficulties are met with. First of all, it varies much in width, and sometimes the change from wide to narrow is so sudden that, if not faulted, it seems to form curious pockets (Fig. 27), as though there had been a cleavage of two walls without any reef matter (Fig. 27, *a*), which, when followed, may widen out into a good, solid, well-formed lode (Fig. 27).

In the wide body, or pocket, the foot-wall is the only good gold-bearing part; but if the lode is regular, the gold is distributed throughout it, and the yield may amount to ounces. Generally a thin layer of dark slate runs through the middle of the pocket (Fig. 26, *e*, and Fig. 27, *b*), but if the body is smaller, these layers appear with the black slate only next to them, also bearing gold, and the "ribbon bar" is not to be seen.

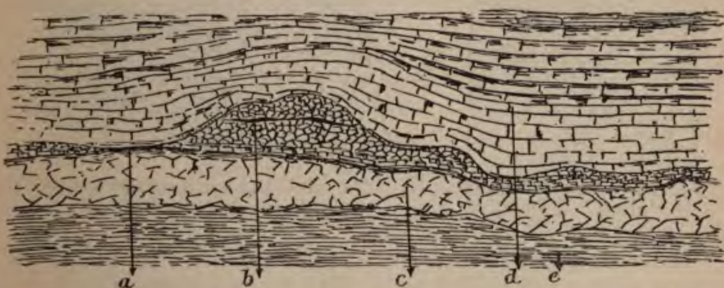


Fig. 27.—Variation of the reef along the strike.—*a*, Reef pinched; *b*, thin layer of dark slate running through the pocket; *c*, diorite; *d*, chlorite schist and sandstone; *e*, shale.

The quartz on the foot-wall often occurs in layers (Fig. 26, *f*). Where the reef has been pinched or shifted, flat slate-like quartz pieces, with signs of gold, occur in the cleavage planes.

Diorite dykes near the lode are rich in gold, but a moderate quantity only is found in those at a greater distance from it. The yellow clay resulting from the decomposition of the diorite contains much free gold.

Often at a lower level the ore has more pyrites and less free gold; therefore, the assay is more reliable than the panning test. Where the reef is much disturbed by the dykes, this reef is a mixture of igneous rock, quartz, quartzite, and schist, in which the gold, though often very visible, is patchy. When this happens it is advisable to drive along the ore on the side which

shows a regular formation on the surface. The same appearances are met with in sinking as in driving.

In looking for a payable body called "chute," care should be taken to continually pan and prove the good gold-bearing rock, and not to drive or sink where the gold in the ore is scanty.

A chute may be large or small, and may vary from 10 feet to 200 feet horizontally. Most chutes of gold follow a zig-zag course, as in Fig. 28. Hence shafts are often sunk through the rich surface portion of this lode into the poor ground below, and the continuation of the lode is missed.

Fig. 28.—Zig-zag form of a "chute" or shoot.

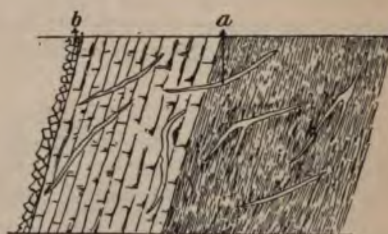


Fig. 29.—Leaders near the reef.—*a*, Leaders; *b*, part of reef.

The contiguous formation is interspersed with numerous quartz strings and leaders, some of which lead to the main body, while others are independent and pinch out to nothing in each direction. These sometimes contain good gold, and, consequently, often mislead a prospector (Fig. 29).

The next band running nearest to this may be found either close by or even as far off as 4000 feet, according to the degree of the disturbance of the bed. It is accompanied by much greenstone in thinnish layers intruded between the beds which occur either close to the reef or in the schists near it. In other places it breaks across the strata so as to make it difficult to trace the outcrops.

In the easterly ranges the band occurs in a solid mass so that broad outcrops can be followed for some distance. Greenstone layers and schists run along the foot-wall; while a quartzitic sandstone forms the hanging-wall. In the west the same band is apparently subdivided in two, three, or more smaller lodes. Greenstone and slate run along the middle vein, and quartzitic sandstone on the hanging side of the upper lode. The green-

stone here also frequently strikes across the beds. The chutes on this band are in parts difficult, and in others easy to locate.

Where the formation shows the stratification well, the reef on the surface will appear solid and be exceedingly rich. If the surface is decomposed or disturbed, the solid reef may be hidden, or present very brittle yellow schistose layers, which are often so powdery (decayed) that the water carries off the fine gold grains from the surface, and consequently leaves the remainder valueless. Again, difficulties in tracing the reef may arise when it is covered by the surface wash due to heavy rainfalls.

The reef matter itself is mainly a fine-grained quartzite of a blue-grey colour.

In the easterly part little leaders from ½ to 1 inch in thickness are found scattered in the reef body; some are milky-white, others very dark. Near the latter very rich gold occurs, and the leader itself also is important through its having an immense quantity of visible gold (Fig. 30, *f*).

It is a sign of poor ore where the white leaders are seen (Fig. 30, *e*). The width of the reef varies from 1 to 100 feet; the reef dips at an angle of 50° to the south (Fig. 30).

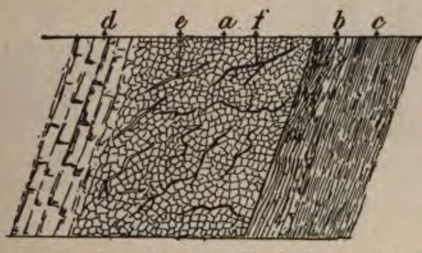


Fig. 30.—Eastern reef sections.—*a*, Reef; *b*, greenstone; *c*, chloritic schists; *d*, quartzite; *e*, white leaders of dark quartz leaders.

In the west the lodes also contain fine-grained quartz, which is of a dark blue-grey colour in some places, light blue in others.

In the adjoining formations small gold-bearing leads of a light grey colour are scattered in the rock near the lode. The thickness of these lodes varies from 1 to 24 inches, dipping about 75° to the south; but in places some are nearly vertical (Fig. 31).

The foot-wall is well defined; but on the hanging-wall of the southerly one the quartzite unites with the reef or lode. The lodes in the west contain very rich gold; but in some parts they are too small to work profitably owing to the large amount

of dead rock that has first to be removed by blasting. In other parts again, the slate, about 1 foot on each side, will bear good gold. Also, in some cases two lodes unite.

The horizontal chutes are, on the east, about 200 feet in length, and far apart from each other; while on the west they are 50 to 75 feet long, and closer together.

The gold contained in the ore on this whole line is on the average about 18 dwts. to 1 ounce per ton of 2000 lbs. Sulphide of iron exists only in small quantities. Sometimes the pyrites is much oxidised and coats the gold. The usual manner of removing this is to hold the pyrites obtained by panning in a clean shovel over the fire until red hot and no fumes can be seen. On panning this again the clean gold seen will indicate

Fig. 31. — Western reef sections. *a*, Lodes; *b*, quartzite; *c*, greenstone; *d*, slate; *e*, chloritic schists.

Fig. 32. — *a*, Coarse-grained quartz; *b*, fine-grained quartz.

the value of the rock. The quartz is in small crystals, the crevices of which contain the auriferous pyrites. The gold is more evenly distributed in the finer than in the coarser quartz, and is easily seen with a magnifying glass (Fig. 32).

It is necessary to be careful in sampling the lodes or reef on this line, as the yield may be less than 1 ounce per ton if the operation is properly carried out, to an apparent one of many ounces when it has been carelessly performed.

The reef or lode is very erratic in its occurrence; in the west the lodes often widen out in the pockets, containing large quantities of rich gold ore. These pockets are long and round in general form, tapering off into thin veins or merging into a small seam of grey pot-clay between two well-defined slaty walls

(Fig. 33), which, when followed up, form an easy guide to other pockets.

These walls readily slip, so that timbering is necessary in many places (see *Timbering*). The mountain sides often show small surface veins following the dip, many of which will be found to run into a larger body.

Fig. 33.—Reef pockets.

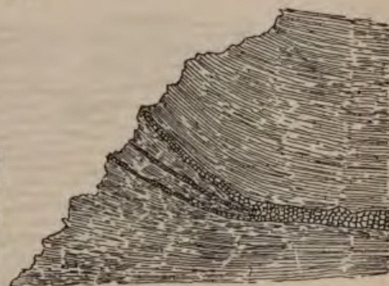


Fig. 34.—Three small leaders unite into a large body, which is very conspicuous on Moodies Hill.

Fig. 35 shows the interblending and parting of lodes.

The material between these veins may have been laid down by water. The whole bends on account of the oxidised surface, but where it becomes solid it goes down in a regular dip (Fig. 34).

The lodes are separated by partings of irregular thickness occasionally blending together for a short distance and then separating into several smaller lodes (Fig. 35).

Whenever two lodes meet, the reef matter looks like alternating quartz and slate, and bears good gold (Fig. 36).

Many good gold-bearing gash veins of various forms and running in all directions occur in the immediate vicinity of the lode, which would be well worth working.

The east main belt is also accompanied by two lodes occupying a similar relative position as those just noticed. The reef matter is quartz, bounded by quartzitic sandstone.

In this body a number of leaders run across the strike. These are the actual gold-bearing parts. There are also many

Fig. 36.—Two lodes uniting and appearing like alternating quartz and slate.

Fig. 37.—Leaders traversing a quartzose body.

pockets of blackish matter, more or less quartzose, which could be profitably worked (Fig. 37).

The outcrop can be traced for a few miles, but has not been opened up the whole length. It may differ in other places. Diorite dykes frequently occur, cutting through the strata, but the solid lode is not always disturbed in the east; but in the west, where it is traceable with difficulty, many perplexing variations are met with.

In the last band to be noticed, that nearest to the granite, numerous dykes have affected the lode, and the granite is distinctly seen.

On the east of Junction and from thence westwards to the Elephant's Kloof and Highland's Creek, it is fairly regular and traceable; beyond this the curve is interrupted by numerous dykes. These igneous rocks form hillocks running at right angles to the stratification of the auriferous belts (see Plate II.).

Between Barberton and Moodies the lodes and beds are regular, the pressure of the dykes having been less great, and their position more conformable with the beds. The reef consists of coarse quartz, which is sometimes divided by leaves of shale. The colour of these is greyish-white and bluish-white, with frequent veins of a greenish tint containing rich gold. The foot-wall is formed of chloritic schists, which, close to the reef, occur in red hard quartz-like leaves, containing much iron pyrites and sometimes visible gold. Immediately beyond the hanging-wall is a very wide quartzite bar, bearing gold, where the ore body is pinched (Fig. 38).

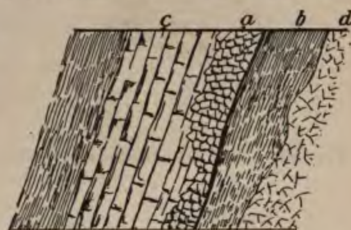


Fig. 38.—Section of reef near the granite.—*a*, Reef; *b*, chloritic schist; *c*, quartzite; *d*, rotten granite.

The general dip is 50° to 75° to the south or east, according as the strike varies, but always overlying and descending with the granite. The lode varies from 1 to 60 feet in width.

The chutes here are of smaller size, often dividing, the intervening matter being either the neighbouring formation or reef matter. This auriferous band presents many alternations of widening and pinching, of poorness and richness.

In the Elephant's Kloof on the east, the reef mass is turned over flat, the main portion dipping downwards at a right angle below (Fig. 39).

The nearest band in the westerly part is very much broken up; but chutes are traceable for short distances which are often very disappointing; for the rich part is sometimes entirely lost or is not big enough for profitable working. This may be due to landslips. Fig. 40 represents one such instance as seen on a hill side in Concession Creek.

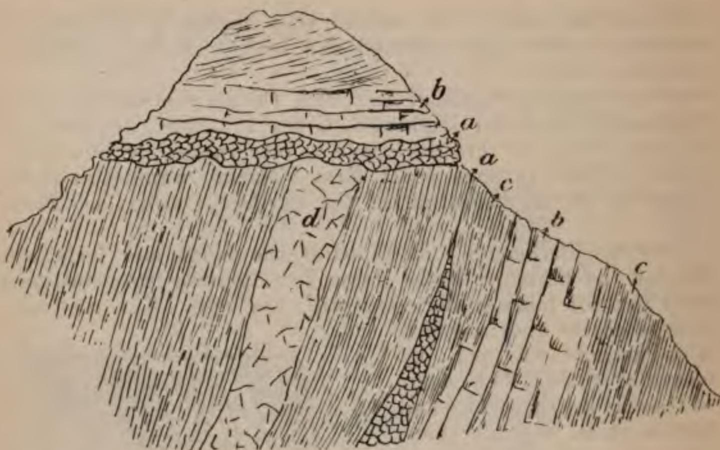


Fig. 39.—Reef occurrence in Elephant's Kloof.—*a*, Reef ; *b*, quartzite ; *c*, chloritic schists ; *d*, diorite.

Fig. 40.—A shifted reef.—*a*, Reef ; *b*, boulders of diorite ; *c*, lamina of clay and small pieces of quartz.

The strata, even when regular, are twisted, as seen in the local steep kloof. The connection of the main belt formation and the granite basin cannot be seen on the surface, as the junction is covered by decomposed slate and granite (called rotten granite).

From the above we observe that the reefs are more openly developed in the eastern main belt, especially where the formation takes a large bend from south to north, and from west to east in a circular form. Many chutes of rich ore will probably be found in this belt when prospecting is proceeded with in earnest. They will occur with dips of from 50° to 75° in crescent-like strikes, as in Fig. 41.

The lodes will necessarily vary in dip, length, width, and quality according to the amount of disturbance of the strata by the intruding eruptive rocks.

Fig. 41.—The reef outcrop in the East De Kaap, strike crescent-like.—*a*, Strike of granite; *b*, dip; *c*, strike of reefs; *d*, strike of conglomerate beds.

In the west the belt is, generally, more closely pressed together and occurs in smaller bodies.

In the southern portion it dips at 75°, in the centre from vertical to 75°, and close to the granite from 50° to 75° (Fig. 42).

In the main belt ranges the outcrops of the beds, although broken, shifted or pinched, can be approximately followed by walking from the east to the west.

The harder rocks stand out and appear like a frame-work of the hills; it may, therefore, be expected that energetic prospect-

ing will discover many new chutes which, however unpromising at the surface they may appear, will probably prove to be much richer lower down, if they are fissure veins. When such pro-

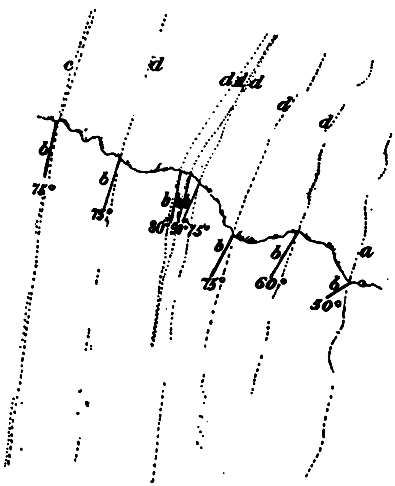


Fig. 42.—The western De Kaap reefs, showing the smaller size of the ore bodies as compared with those of the eastern De Kaap.—*a*, Boundary line of granite; *b*, dip; *c*, strike of conglomerate beds; *d*, strike of reefs.

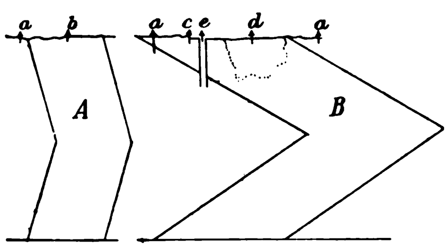


Fig. 43.—Chutes.—*A*, Descends 75°; *a*, poor ore; *b*, rich ore. *B*, Descends 30°; *a*, poor ore; *c*, rich ore; *d*, decomposed reef matter; *e*, shaft sunk through the chute into the poor ore.

mises are not realised, the chutes are probably small, have a zig-zag slanting downward course, and appear interruptedly rich and poor on the surface (Fig. 43).

For instance, in the Ivy Mine, in the west, they incline 30°, and in the Pioneer Mine 75° to the east.

Again, a chute in one band is generally represented by a corresponding chute in the next band; hence if one is seen in a reef running about east and west, similar chutes will be found on the other band, as shown in Plate III., which gives examples of mines already working in the west.

No. 12, Pioneer Mine, opposite No. 11, Alpine Mine.

No. 10, Snowden Mine, opposite No. 9, Ivy Mine.

No. 7, La Fortuna Mine, opposite No. 8, a rich strike lately discovered, probably an extension of the Ivy Mine.

No. 5, Grahamstown Reef, opposite No. 6, Umvoti Reef.

In the east—No. 2, Zwaart Kopjes Mine, opposite No. 1, Sheba Mine, and No. 3, Woodstock Mine.

No. 4, Thomas Mine, opposite No. 1, Sheba Mine.

No. 13, Elephant's Kloof Mine, opposite No. 14, Kimberley Sheba Mine.

There are many other rich and large chutes which could be developed into good profitable concerns when the present tentative procedures are replaced by systematic workings.

As soon as a prospector discovers a good reef, it is usually secured by capitalists who in many cases do not develop it, but utilise it as a basis for speculation. To retain possession they have merely to pay the hire and license; consequently, the general public is debarred from the benefits of such discoveries.

The situation of many properties is favourable enough to allow of driving (the cheapest method of working) and of constructing inexpensive water-races, as power for the batteries.

3. Output of the De Kaap Main Belt.—The following tables show the gold outputs of several properties in the De Kaap Main Belt, selected from the official reports of the Chambers of Mines at Barberton.

The reader will notice there are many small outputs quoted; these no doubt are merely trial crushings. On the other hand, the larger outputs give evidence of the high value and permanence of this field

GOLD OUTPUT IN THE DE KAAP MAIN BELT.

SHEBA MINE.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.*	1897.*	1898.*
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs.	ozs.	ozs.
January, . .	..	..	..	3,415 16 11	2,538 1 12	7,966 8 0	4356·292	10,010	4,790	6,400
February, .	..	..	..	3,013 1 13	1,161 11 13	5,987 15 6	4323·953	10,028	7,695	5,930
March, . .	3,403 10 0	120 17 0	617 16 0	3,032 2 21	2,875 5 16	6,472 0 3	1682·157	12,500	6,557	4,369
April, . . .	2,229 9 0	109 0 8	1,061 0 0	3,400 12 13	3,209 3 22	7,955 0 2	1135·262	10,340	6,275	4,754
May, . . .	1,703 0 0	209 0 0	2,822 0 0	2,792 7 6	3,858 6 19	6,237 4 8	1793·581	10,024	7,919	5,305
June, . . .	2,078 7 0	776 4 4	2,628 0 0	2,490 19 14	4,490 1 15	5,179 0 0	1402·387	8,589	7,448	5,420
July, . . .	1,889 0 0	186 3 0	2,665 11 6	2,907 19 2	2,817 10 10	8,142 9 0	2368·362	8,100	8,070	6,020
August, . .	1,470 15 0	134 19 11	3,600 0 0	1,302 13 8	2,550 11 23	7,586 0 5	4226·014	8,005	7,638	5,920
September, .	783 0 0	166 12 12	3,402 14 12	4,045 0 0	2,460 13 13	5,005 2 3	5147·577	7,066	6,000	5,805
October, . .	1,113 4 0	247 18 6	3,191 4 2	5,501 18 8	3,357 15 12	3,938 5 7	6430·113	6,352	7,168	5,425
November, .	846 4 0	..	3,731 7 16	3,001 1 16	5,080 4 7	5,296 2 0	6023·348	5,131	10,032	4,229
December, .	622 2 0	..	3,591 10 14	2,281 19 6	5,963 5 11	4,565 6 9	6070·031	5,340	9,005	4,570
Total, . .	16,138 11 0	1,950 14 17	27,311 4 2	37.185 11 22	40,462 12 5	74,330 12 19	44959·077	..	..	..

UNITED IVY MINE (MOODIES).

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.*	1897.*	1898.*
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs.	ozs.	ozs.	ozs.
January, . .	..	100 5 0	47 8 0	282 5 0	193 10 0	382·40	156·000	364	440	720
February, .	..	114 5 0	159 4 0	387 9 0	170 4 0	474·65	..	624	465	505
March, . .	..	108 11 0	201 19 0	372 0 0	329 0 0	316·00	70·000	590	436	630
April, . . .	..	110 0 0	191 17 0	403 6 12	281 1 0	378·45	110·500	649	420	615
May, . . .	..	104 8 0	215 0 0	336 18 0	414 2 0	320·00	140·500	569	..	670
June, . . .	..	101 0 0	153 10 0	352 10 12	454 6 0	337·00	159·000	702	357	810
July, . . .	..	125 3 0	106 7 0	304 12 0	558 10 0	240·00	224·500	685	525	830
August, . .	..	119 13 0	130 15 0	274 15 0	657 17 0	223·00	184·000	612	565	710
September, .	..	101 5 0	150 0 0	211 13 0	554 14 0	374·00	305·000	614	570	605
October, . .	..	134 16 0	116 10 0	278 14 0	549 4 0	153·00	267·500	545	600	565
November, .	..	135 5 0	119 0 0	239 9 12	373 13 0	147·00	300·000	..	660	595
December, .	105 7 0	108 17 0	204 3 0	305 3 0	349 14 0	143·00	309·350	..	750	..
Total, . .	105 7 0	1,363 8 0	1,795 13 0	3,748 15 12	4,918 15 0	3488·50	2226·350	..	..	..

* *African Review.*

UNITED PIONEER MINE (MOODIES).

	1889.			1890.			1891.			1892.			1893.			1894.		
	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.
January, ...	381	0	0	..			264	11	0	176	11	10	188	8	0	86	0	0
February, . . .	536	0	0	..			421	0	0	168	12	0	157	0	0	59	6	0
March, ...	283	10	0	..			325	10	0	147	1	0	233	0	0	56	8	0
April, ...	210	10	0	272	5	0	344	9	0	161	6	0	238	13	0	41	0	0
May, ...	218	0	0	350	4	0	324	14	0	205	2	0	222	4	0	60	0	0
June, ...	227	9	0	209	11	6	401	11	0	212	10	0	181	1	1	49	0	0
July, ...	281	0	0	237	11	17	34[illegible]	11	12	159	17	0	168	12	0	54	1	0
August, ...	312	8	0	258	10	0	206	8	0	258	3	0	203	10	0	44	6	5
September, . . .	167	18	0	119	18	0	229	2	0	230	17	0	144	3	0	83	3	0
October, ...	119	11	0	152	15	0	176	1	0	204	17	0	178	7	0	38	1	5
November, . . .	147	0	0	186	0	0	193	19	12	193	2	0	98	10	0	44	0	0
December, . . .	..			286	10	0	101	12	12	152	17	0	97	18	0	50	0	0
Total, ...	2884	6	0	2073	4	23	3422	9	12	2270	15	10	2111	6	1	665	5	10

CENTRAL MONTROSE MINE.

	1889.			1890.			1891.			1892.			1893.			1894.
	ozs.	dwts.	grs.	ozs.	dwts	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.
January, ...	..			465	0	0	416	0	0	182	0	0	313	0	0	..
February, . . .	..			286	0	0	268	12	0	122	10	0	..			187
March, ...	..			350	4	0	412	15	0	96	4	0	..			..
April, ...	..			243	0	0	611	18	0	..			..			310
May, ...	..			158	10	0	252	1	0	187	16	0	88	13	0	..
June, ...	..			219	5	0	311	8	0	299	4	0	..			..
July, ...	..			272	10	0	264	0	0	233	6	0	..			..
August, ...	..			303	0	0	162	11	0	57	2	0	..			..
September, . . .	..			..			..			..			..			..
October, ...	..			479	16	0	153	12	0	63	0	0	..			..
November, . . .				..			..			..			..			..
December, . . .	717	10	0	308	15	0	..			87	16	0	322	10	0	..
Total, ...	717	10	0	3167	0	0	2852	17	0	1328	18	0	724	3	0	497

UNION.

	1889.		1890.		1892.		1895.
	ozs.	dwts.	ozs.	dwts.	ozs.	dwts.	ozs.
January, .	242	0	174	0	..		..
February, .	801	0	158	0	..		..
March, . .	190	12	..		..		..
April, . .	196	0	119	17	..		205·000
May, . .	243	10	116	11	..		98·000
June, . .	308	3	132	16	..		157·000
July, . .	225	0	..		65	15	63·075
August, .	386	0	..		42	10	..
September,	272	2	..		34	2	..
October, .	288	0	..		22	9	..
November,	86	0	..		..		..
December,	..		..		25	15	..
Total, .	3238	7	701	4	190	11	523·075

MOUNT MORGEN.

	1889.	1890.			1891.			1893.	
	ozs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.
January, .	..	..			147	17	18	..	
February, .	..	..			119	9	12	70	7
March, . .	164	..			215	16	0	47	8
April, . .	..	..			39	0	0	75	4
May, . .	..	348	19	19	..			72	0
June, . .	..	300	13	16	..			18	0
July, . .	..	201	0	0	..			18	0
August, .	..	139	4	0	..			25	15
September,	..	287	0	0	..			..	
October, .	..	107	16	4	..			..	
November,	..	207	15	0	..			..	
December,	..	101	2	0	..			..	
Total, .	164	1693	10	15	522	3	6	328	14

	ORIENTAL AND SHEBA VALLEY.			EDWIN BREY.			JOE'S LUCK.		
	1890.	1891.	1892.	1891.	1892.	1893.	1889.	1893.	1897.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.
January,	..	830 6 0	..	505 2 0	232 0 0	67 13 0	..	66 18 0	286
February,	..	309 4 3	..	238 10 0	301 15 0	..	..	..	199
March,	..	823 11 2	..	70 0 0	280 6 0	..	74 12 0	112 16 0	275
April,	..	722 12 15	..	209 10 0	268 4 0	108 0 0	..	136 19 0	266
May,	..	416 7 1	442 12 2	306 7 0	168 0 0	..	..	129 6 0	215
June,	..	649 2 3	397 12 14	240 2 0	226 8 0	52 4 0	..	65 14 0	251
July,	130 10 0	541 14 6	..	211 15 0	224 17 0	22 0 0	..	87 0 0	221
August,	660 0 0	..	..	350 16 0	279 17 0	..	..	248 0 0	272
September,	279 16 0	..	..	300 6 0	158 15 0	..	..	367 0 0	392
October,	401 13 0	..	..	269 15 0	299 3 0	..	..	318 18 0	181
November,	376 1 12	..	..	303 0 0	..	57 7 0	..	166 18 0	158
December,	270 16 0	..	..	280 8 0	68 5 0	..	..	161 15 0	152
Total,	2118 16 12	4292 17 6	840 4 16	3285 11 0	2507 10 0	307 4 0	74 12 0	1861 4 0	2868

	THOMAS.			WEENEN COUNTY SYND.			SUNDRY SYND.		
	1889.	1890.	1893.	1889.	1890.	1891.	1891.	1895.	1897.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. qrs.	ozs. dwts. grs.	ozs.	ozs.
January,	..	404 14 0	73 17 0	..	63 10 12	..	177 6 4	727·505	264
February,	..	212 6 2	101 10 0	..	..	..	35 6 0	989·000	343
March,	..	..	187 0 0	..	..	61 0 0	43 6 6	925·950	361
April,	..	..	219 4 0	..	..	85 0 0	161 6 7	388·150	474
May,	..	..	309 0 0	..	..	78 0 0	462 1 0	1232·755	407
June,	..	..	248 16 0	..	..	..	246 13 0	429·150	289
July,	..	..	247 15 0	..	..	..	273 3 18	467·580	269
August,	..	..	547 16 0	..	..	..	75 16 12	113·400	248
September,	..	..	50 0 0	..	..	..	254 14 12	20·650	98
October,	..	..	..	..	..	..	186 12 6	46·650	142
November,	52 0 0	..	..	242 0 0	..	..	183 8 0	81·450	231
December,	163 0 0	..	..	..	..	..	243 14 3	2·750	25
Total,	215 0 0	617 0 2	1984 18 0	242 0 0	63 10 12	224 0 0	2343 7 20	5424·990	3151

To face p. 48.

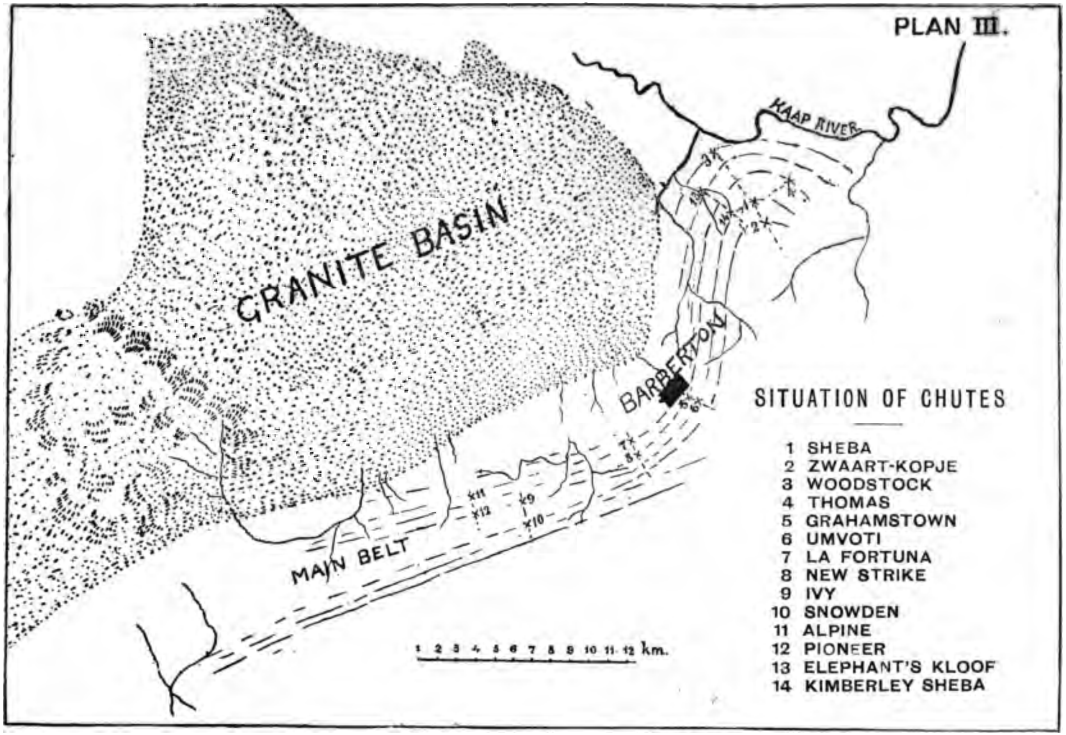


PLATE III.

	VELDEVREDEN ESTATE.			MOODIES COMP.		JOE'S REEF.	WOODBINE.	
	1893.	1894.	1895.	1889.	1890.	1895.	1889.	1894.
	ozs. dwts. grs.	ozs	ozs.	ozs. dwts grs.	ozs. dwts. grs.	ozs.	ozs. dwts. grs	ozs.
January,	..	282·40	56·000	..	45 16 0	..	80 0 0	59·60
February,	..	474·65	30·000	..	..	..	..	71·55
March,	..	316·00	39·500	..	332 14 0	..	..	137·90
April,	..	378·45	59·100	51 5 0	..	247·000	..	75·95
May,	..	326·00	57·150	78 0 0	202 6 16	..	..	276·10
June,	..	337·00	28·450	225 0 0	53 8 18	299·500	..	192·00
July,	..	240·00	91·750	40 0 0	244 15 7	..	..	257·50
August,	..	223·00	74·450	15 0 0	228 19 11	376·650	..	193·50
September,	47 3 0	374·00	..	93 0 0	365 17 0	167·950	..	193·55
October,	29 3 0	153·00	..	5 3 0	7 18 2	207·950	141 8 0	272·45
November,	31 9 0	147·00	..	232 0 0	84 12 5	258·500	63 0 0	309·50
December,	33 9 0	143·00	..	257 19 0	127 7 0	206·525	..	100·80
Total,	141 4 0	3394·50	436·400	997 7 0	1693 14 11	1764·075	287 8 0	1946·70

	ORATAVA.		CLUTHA.		ADAMANTA.		WYLDSDALE GOLD EXPLOR. CO.	
	1893.	1895.	1891.	1893.	1893.	1897.	1891.	1892.
	ozs. dwts. grs.	ozs.	ozs. dwts. grs.	ozs. grs. dwts.	ozs. dwts. grs.	ozs.	ozs. dwts. grs.	ozs. dwts. grs.
January,	52 10 0	120·650	..	90 0 0	..	25	..	210 0 0
February,	27 0 0	38·400	..	65 0 0	..	39	..	62 0 0
March,	64 18 0	10·250	..	104 0 0	..	34	..	93 0 0
April,	54 17 0	..	..	226 0 0	48 0 0	61	99 9 0	175 0 0
May,	47 3 0	..	..	206 0 0	..	..	..	37 10 0
June,	47 1 0	..	..	146 0 0	..	..	..	104 0 0
July,	75 16 0	..	..	111 6 0	51 0 0	..	..	..
August,	93 1 12	..	..	109 0 0	51 0 0	39	..	..
September,	..	..	..	70 0 0	67 4 0	..	..	..
October,	..	..	..	97 0 0	43 0 0	30	..	..
November,	..	..	..	35 14 0	45 10 0	..	..	..
December,	..	..	67 1 0	27 17 0	..	43	..	..
Total,	462 6 12	169·300	67 1 0	1287 17 0	305 14 0	271	99 9 0	681 10 0

GOLD OUTPUT IN THE DE KAAP MAIN BELT.

SHEBA MINE.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.*	1897.*	1898.*
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs.	ozs.	ozs.
January, . .	..	..	..	3,415 16 11	2,538 1 12	7,966 8 0	4356·292	10,010	4,790	6,400
February, .	..	..	..	3,013 1 13	1,161 11 13	5,987 15 6	4323·953	10,028	7,695	5,930
March, . .	3,403 10 0	120 17 0	617 16 0	3,032 2 21	2,875 5 16	6,472 0 3	1682·157	12,500	6,557	4,369
April, . . .	2,229 9 0	109 0 8	1,061 0 0	3,400 12 13	3,209 3 22	7,955 0 2	1135·262	10,340	6,275	4,754
May, . . .	1,703 0 0	209 0 0	2,822 0 0	2,792 7 6	3,858 6 19	6,237 4 8	1793·581	10,024	7,919	5,305
June, . . .	2,078 7 0	770 4 4	2,628 0 0	2,490 19 14	4,490 1 15	5,179 0 0	1402·387	8,589	7,448	5,420
July, . . .	1,889 0 0	186 3 0	2,665 11 6	2,907 19 2	2,817 10 10	8,142 9 0	2368·362	8,100	8,070	6,020
August, . .	1,470 15 0	134 19 11	3,600 0 0	1,302 13 8	2,550 11 23	7,586 0 5	4226·014	8,005	7,638	5,920
September, .	783 0 0	166 12 12	3,402 14 12	4,045 0 0	2,460 13 13	5,005 2 3	5147·577	7,066	6,000	5,805
October, . .	1,113 4 0	247 18 6	3,191 4 2	5,501 18 8	3,357 15 12	3,938 5 7	6430·113	6,352	7,168	5,425
November, .	846 4 0	..	3,731 7 16	3,001 1 16	5,080 4 7	5,296 2 0	6023·348	5,131	10,032	4,229
December, .	622 2 0	..	3,591 10 14	2,281 19 6	5,963 5 11	4,565 6 9	6070·031	5,340	9,005	4,570
Total, . .	16,138 11 0	1,950 14 17	27,311 4 2	37.185 11 22	40,462 12 5	74,330 12 19	44959·077	..	..	..

UNITED IVY MINE (MOODIES).

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.*	1897.*	1898.*
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs.	ozs.	ozs.	ozs.
January, . .	..	100 5 0	47 8 0	282 5 0	193 10 0	382·40	156·000	364	440	720
February, .	..	114 5 0	159 4 0	387 9 0	170 4 0	474·65	..	624	465	505
March, . .	..	108 11 0	201 19 0	372 0 0	329 0 0	316·00	70·000	590	436	630
April, . . .	..	110 0 0	191 17 0	403 6 12	281 1 0	378·45	110·500	649	420	615
May, . . .	..	104 8 0	215 0 0	336 18 0	414 2 0	320·00	140·500	569	..	670
June, . . .	..	101 0 0	153 10 0	352 10 12	454 6 0	337·00	159·000	702	357	810
July, . . .	..	125 3 0	106 7 0	364 12 0	558 10 0	240·00	224·500	685	525	830
August, . .	..	119 13 0	130 15 0	274 15 0	657 17 0	223·00	184·000	612	565	710
September, .	..	101 5 0	150 0 0	211 13 0	554 14 0	374·00	305·000	614	570	605
October, . .	..	134 16 0	116 10 0	278 14 0	549 4 0	153·00	267·500	545	600	565
November, .	..	135 5 0	119 0 0	239 9 12	373 13 0	147·00	300·000	..	660	595
December, .	105 7 0	108 17 0	204 3 0	305 3 0	349 14 0	143·00	309·350	..	750	..
Total, . .	105 7 0	1,363 8 0	1,795 13 0	3,748 15 12	4,918 15 0	3488·50	2226·350	..	..	..

* *African Review.*

UNITED PIONEER MINE (MOODIES).

	1889.			1890.			1891.			1892.			1893.			1894.		
	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.
January,	381	0	0	..			264	11	0	176	11	10	188	8	0	86	0	0
February,	536	0	0	..			421	0	0	168	12	0	157	0	0	59	6	0
March,	283	10	0	..			325	10	0	147	1	0	233	0	0	56	8	0
April,	210	10	0	272	5	0	344	9	0	161	6	0	238	13	0	41	0	0
May,	218	0	0	350	4	0	324	14	0	205	2	0	222	4	0	60	0	0
June,	227	9	0	209	11	6	401	11	0	212	10	0	181	1	1	49	0	0
July,	281	0	0	237	11	17	348	11	12	159	17	0	168	12	0	54	1	0
August,	312	8	0	258	10	0	206	8	0	258	3	0	203	10	0	44	6	5
September,	167	18	0	119	18	0	229	2	0	230	17	0	144	3	0	83	3	0
October,	119	11	0	152	15	0	176	1	0	204	17	0	178	7	0	38	1	5
November,	147	0	0	186	0	0	193	19	12	193	2	0	98	10	0	44	0	0
December,	..			286	10	0	101	12	12	152	17	0	97	18	0	50	0	0
Total,	2884	6	0	2073	4	23	3422	9	12	2270	15	10	2111	6	1	665	5	10

CENTRAL MONTROSE MINE.

	1889.			1890.			1891.			1892.			1893.			1894.
	ozs.	dwts.	grs.	ozs.	dwts	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.
January,	..			465	0	0	416	0	0	182	0	0	313	0	0	..
February,	..			286	0	0	268	12	0	122	10	0	..			187
March,	..			350	4	0	412	15	0	96	4	0	..			..
April,	..			243	0	0	611	18	0	..			..			310
May,	..			158	10	0	252	1	0	187	16	0	88	13	0	..
June,	..			219	5	0	311	8	0	299	4	0	..			..
July,	..			272	10	0	264	0	0	233	6	0	..			..
August,	..			303	0	0	162	11	0	57	2	0	..			..
September,	..			..			..			..			..			..
October,	..			479	16	0	153	12	0	63	0	0	..			..
November,	..			..			..			..			..			..
December,	717	10	0	308	15	0	..			87	16	0	322	10	0	..
Total,	717	10	0	3167	0	0	2852	17	0	1328	18	0	724	3	0	497

	UNION.								MOUNT MORGEN.								
	1889.		1890.		1892.		1895.		1889.	1890.			1891.			1893.	
	ozs.	dwts.	ozs.	dwts.	ozs.	dwts.	ozs.		ozs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.
January,	242	0	174	0	..		..		..	..			147	17	18	..	
February,	801	0	158	0	..		..		..	..			119	9	12	70	7
March,	190	12	..		..		..		164	..			215	16	0	47	8
April,	196	0	119	17	..		205·000		..	..			39	0	0	75	4
May,	243	10	116	11	..		98·000		..	348	19	19	..			72	0
June,	308	3	132	16	..		157·000		..	300	13	16	..			18	0
July,	225	0	..		65	15	63·075		..	201	0	0	..			18	0
August,	386	0	..		42	10	..		..	139	4	0	..			25	15
September,	272	2	..		34	2	..		..	287	0	0	..			..	
October,	288	0	..		22	9	..		..	107	16	4	..			..	
November,	86	0	..		..		..		..	207	15	0	..			..	
December,	..		..		25	15	..		..	101	2	0	..			..	
Total,	3238	7	701	4	190	11	523·075		164	1693	10	15	522	3	6	326	14

	ORIENTAL AND SHEBA VALLEY.			EDWIN BREY.			JOE'S LUCK.		
	1890.	1891.	1892.	1891.	1892.	1893.	1889.	1893.	1897.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.
January,	..	830 6 0	..	505 2 0	232 0 0	67 13 0	..	66 18 0	286
February,	..	309 4 3	..	238 10 0	301 15 0	..	..	..	199
March,	..	823 11 2	..	70 0 0	280 6 0	..	74 12 0	112 16 0	275
April,	..	722 12 15	..	209 10 0	268 4 0	108 0 0	..	136 19 0	266
May,	..	416 7 1	442 12 2	306 7 0	168 0 0	..	..	129 6 0	215
June,	..	649 2 3	397 12 14	240 2 0	226 8 0	52 4 0	..	65 14 0	251
July,	130 10 0	541 14 6	..	211 15 0	224 17 0	22 0 0	..	87 0 0	221
August,	660 0 0	..	..	350 16 0	279 17 0	..	..	248 0 0	272
September,	279 16 0	..	..	300 6 0	158 15 0	..	..	367 0 0	392
October,	401 13 0	..	..	269 15 0	299 3 0	..	..	318 18 0	181
November,	376 1 12	..	..	303 0 0	..	57 7 0	..	166 18 0	158
December,	270 16 0	..	..	280 8 0	68 5 0	..	..	161 15 0	152
Total,	2118 16 12	4292 17 6	840 4 16	3285 11 0	2507 10 0	307 4 0	74 12 0	1861 4 0	2868

	THOMAS.			WEENEN COUNTY SYND.			SUNDRY SYND.		
	1889.	1890.	1893.	1889.	1890.	1891.	1891.	1895.	1897.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs	ozs. dwts. grs.	ozs. dwts. qrs.	ozs. dwts grs.	ozs.	ozs.
January,	..	404 14 0	73 17 0	..	63 10 12	..	177 6 4	727·505	264
February,	..	212 6 2	101 10 0	..	..	..	35 6 0	989·000	343
March,	..	..	187 0 0	..	..	61 0 0	43 6 6	925·950	361
April,	..	..	219 4 0	..	..	85 0 0	161 6 7	388·150	474
May,	..	..	309 0 0	..	..	78 0 0	462 1 0	1232·755	407
June,	..	..	248 16 0	..	..	..	246 13 0	429·150	289
July,	..	..	247 15 0	..	..	..	273 3 18	467·580	269
August,	..	..	547 16 0	..	..	..	75 16 12	113·400	248
September,	..	..	50 0 0	..	..	..	254 14 12	20·650	98
October,	..	..	..	..	..	..	186 12 6	46·650	142
November,	52 0 0	..	..	242 0 0	..	..	183 8 0	81·450	231
December,	163 0 0	..	..	..	..	..	243 14 3	2·750	25
Total,	215 0 0	617 0 2	1984 18 0	242 0 0	63 10 12	224 0 0	2343 7 20	5424·990	3151

To face p. 48.

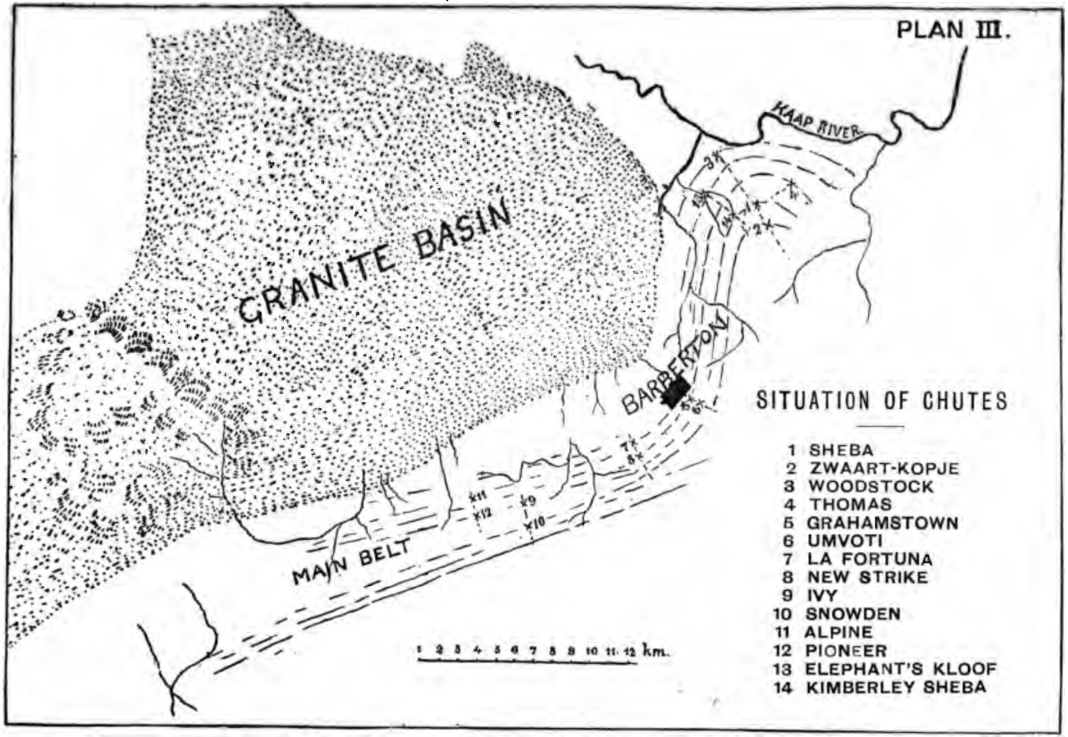


PLATE III.

	VELDEVREDEN ESTATE.			MOODIES COMP.		JOE'S REEF.	WOODBINE.	
	1893.	1894.	1895.	1889.	1890.	1895.	1889.	1894.
	ozs. dwts. grs.	ozs	ozs.	ozs. dwts grs.	ozs. dwts. grs.	ozs.	ozs. dwts. grs	ozs.
January,	..	282·40	56·000	..	45 16 0	..	80 0 0	59·60
February,	..	474·65	30·000	..	..	..	..	71·55
March,	..	316·00	39·500	..	332 14 0	..	..	137·90
April,	..	378·45	59·100	51 5 0	..	247·000	..	75·95
May,	..	326·00	57·150	78 0 0	202 6 16	..	..	276·10
June,	..	337·00	28·450	225 0 0	53 8 18	299·500	..	192·00
July,	..	240·00	91·750	40 0 0	244 15 7	..	..	257·50
August,	..	223·00	74·450	15 0 0	228 19 11	376·650	..	193·50
September,	47 3 0	374·00	..	93 0 0	365 17 0	167·950	..	193·55
October,	29 3 0	153·00	..	5 3 0	7 18 2	207·950	141 8 0	272·45
November,	31 9 0	147·00	..	232 0 0	84 12 5	258·500	63 0 0	309·50
December,	33 9 0	143·00	..	257 19 0	127 7 0	206·525	..	100·80
Total,	141 4 0	3394·50	436·400	997 7 0	1693 14 11	1764·075	287 8 0	1946·70

	ORATAVA.		CLUTHA.		ADAMANTA.		WYLDSDALE GOLD EXPLOR. CO.	
	1893.	1895.	1891.	1893.	1893.	1897.	1891.	1892.
	ozs. dwts. grs.	ozs.	ozs. dwts. grs.	ozs. grs. dwts.	ozs. dwts. grs.	ozs.	ozs. dwts. grs.	ozs. dwts. grs.
January,	52 10 0	120·650	..	90 0 0	..	25	..	210 0 0
February,	27 0 0	38·400	..	65 0 0	..	39	..	62 0 0
March,	64 18 0	10·250	..	104 0 0	..	34	..	93 0 0
April,	54 17 0	..	..	226 0 0	48 0 0	61	99 9 0	175 0 0
May,	47 3 0	..	..	206 0 0	..	..	..	37 10 0
June,	47 1 0	..	..	146 0 0	..	..	..	104 0 0
July,	75 16 0	..	..	111 6 0	51 0 0	..	..	..
August,	93 1 12	..	..	109 0 0	51 0 0	39	..	..
September,	..	..	..	70 0 0	67 4 0	..	..	..
October,	..	..	..	97 0 0	43 0 0	30	..	..
November,	..	..	..	35 14 0	45 10 0	..	..	..
December,	..	..	67 1 0	27 17 0	..	43	..	..
Total,	462 6 12	169·300	67 1 0	1287 17 0	305 14 0	271	99 9 0	681 10 0

	VICTORIA. 1889.	VICTORIA. 1890.	ALPINE. 1889.	ALPINE. 1891.	GREAT SCOT. 1889.	GREAT SCOT. 1891.	ABBOTTS. 1890.	ABBOTTS. 1891.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January,	243 3 0	101 5 0	..	..	..	86 5 0	..	..
February,	197 0 0	..	44 9 0	..	..	108 5 0	..	..
March,	172 12 0	..	..	..	..	93 5 0	..	..
April,	238 10 0	..	..	..	..	78 0 0	..	..
May,	182 5 0	..	..	..	..	85 5 0	..	..
June,	368 17 0	..	112 8 0	..	..	..	..	..
July,	..	..	..	109 9 0	26 0 0	..	..	55 11 0
August,	..	..	..	..	..	..	..	12 6 0
September,	..	..	..	..	..	..	..	..
October,	301 0 0	..	..	..	..	..	..	..
November,	..	..	..	..	..	..	..	..
December,	..	..	..	..	..	..	116 0 0	..
Total,	1703 7 0	101 5 0	156 17 0	109 9 0	26 0 0	451 0 0	116 0 0	67 17 0

	IVY LEAF. 1889.	IVY LEAF. 1890.	MOODIES SYND. 1892.	MOODIES SYND. 1893.	IVY. 1889.	EDWIN BREY BLUE ROCK. 1893.	GOLD RECOV. SYND 1892.	AFRICAN GOLD RECOV. 1893.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January,	..	..	150 10 20	210 19 0	..	..	..	144 16 0
February,	..	11 14 0	43 0 0	160 4 0	..	..	..	129 17 0
March,	..	13 15 0	112 15 10	471 12 18	..	..	..	99 8 0
April,	..	..	52 2 12	214 0 12	..	..	254 12 0	126 15 0
May,	..	..	143 6 0	163 5 0	..	..	487 0 0	..
June,	..	..	262 0 0	118 9 4	..	..	546 16 0	..
July,	..	..	95 5 12	76 4 12	..	..	256 7 0	..
August,	74 12 0	..	315 13 12	30 18 0	..	110 4 0	254 0 0	..
September,	137 0 0	..	284 5 20	13 0 0	..	..	274 8 0	..
October,	..	..	181 7 12	66 0 0	..	..	59 11 0	..
November,	..	..	267 15 0	70 3 0	69 15 0	..	211 6 0	207 11 0
December,	..	..	192 17 0	122 15 18	..	..	..	..
Total,	211 12 0	25 9 0	2100 19 2	1717 11 16	69 15 0	110 4 0	2344 0 0	708 7 0

	CITY OF GRAHAMSTOWN.	CENTRAL.	HAVERLOCK.	AGNES BL.	ANDREWS THOS.*	ANDREWS SYND.	VIRGINIA ESTATE.	NOTHINGHAM QUARRY.	BULLION.
	1891.	1889.	1892.	1895.	1893.	1891.	1892.	1893.	1889.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January, . .	..	130 0 0	46 0 0	..	226 0 0	..	..	..	..
February, . .	..	195 0 0	..	..	93 0 0	..	..	59 14 12	..
March, . . .	..	..	..	..	309 3 12	..	..	33 10 0	..
April, . . .	..	168 0 0	..	..	117 12 0	..	..	..	365 9 0
May, . . .	..	..	..	..	224 0 0	..	..	..	50 0 0
June, . . .	..	..	..	18·900	279 13 0	..	60 7 0	..	..
July, . . .	..	176 0 0	..	..	341 13 0	..	80 0 0	..	..
August, . .	..	..	..	163·130	324 6 0	..	49 0 0	..	..
September, . .	..	..	..	102·000	274 16 0	..	40 0 0	..	..
October, . .	..	..	..	..	244 12 0	165 0 0	45 0 0	..	..
November, . .	56 0 0	..	..	..	228 1 0	120 0 0	68 0 0	..	..
December, . .	..	..	..	..	359 0 0	260 0 0	56 0 0	..	..
Total, . .	56 0 0	669 0 0	46 0 0	284·030	3021 16 12	545 0 0	398 7 0	93 4 12	415 9 0

	HIGHLAND.	THREE SISTERS.	REVOLVER.	KIMBERLEY IMPERIAL.	HERCULES.	SCOTSMAN.	LILIE.	REPUBLIC SYND.
	1899.	1893.	1889.	1889.	1889.	1889.	1890.	1891.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January, . . .	..	..	..	294 15 0	..	..	118 10 0	..
February, . .	122 0 0	41 0 0	215 0 0	407 0 0	..	..	..	..
March, . . .	..	58 3 0	..	..	..	..	..	..
April, . . .	..	66 10 0	78 0 0	..	48 0 0	..	..	..
May, . . .	..	87 7 0	..	..	..	30 12 0	..	..
June, . . .	23 0 0	..	50 0 0	..	..	..	..	..
July, . . .	..	30 3 0	35 0 0	..	..	..	..	..
August, . . .	..	30 15 0	..	..	..	..	..	..
September, . .	..	61 0 0	..	..	..	..	..	..
October, . . .	..	43 0 0	..	..	..	..	..	..
November, . .	..	24 0 0	..	..	..	..	..	293 17 12
December, . .	..	36 10 0	..	..	..	..	..	..
Total, . . .	145 0 0	478 8 0	378 0 0	701 15 0	48 0 0	30 12 0	118 10 0	293 17 12

* Belfast, Dexter, Kimberley Sheba, Lily, Trichards Luck, Shires Reef.

	ALLUVIAL SYND.	BOWFORT PROSP. SYND.	LEWSON.	RIVERSIDE.	BARBERTON G. M. C.	VICTORIA HILL.	NEW BONANZA.	KIDSON.
	1891.	1880.	1889.	1889.	1889.	1891.	1889.	1889.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January, ...	5 13 0	..	..	..	..	..	..	30 0 0
February, ...	..	..	..	..	..	..	..	..
March, ...	..	..	..	..	..	..	..	..
April, ...	..	..	..	..	44 10 0	..	..	..
May, ...	..	..	..	..	..	..	..	..
June, ...	..	..	..	..	..	..	..	..
July, ...	..	..	..	..	..	..	..	..
August, ...	..	..	..	..	..	32 0 0	..	..
September, ...	..	58 0 0	..	..	..	..	24 10 0	..
Octo er, ...	..	..	24 0 0	..	..	..	..	..
November, ...	..	..	..	45 10 0	..	..	..	..
December, ...	..	..	..	..	..	..	..	..
Total, ...	5 ·13 0	58 0 0	24 0 0	45 10 0	44 10 0	32 0 0	24 10 0	30 0 0

	WIMBLEDON.	HERALD.	CASTLE-MAINE.	GOLDEN SHEBANG.	SNOWDEN.	BRIGHTON.	PLEIN D'OR.	
	1889.	1889.	1889.	1890.	1890.	1889.	1889.	1890.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs	ozs. dwts. grs.	ozs. dwts qrs.
January, ...	..	..	..	..	..	..	..	..
February, ...	30 0 0	..	..	..	50 7 0	..	..	..
March, ...	..	32 0 0	..	..	..	..	..	..
April, ...	..	..	78 10 0	55 0 0	..	552 1 0	57 0 0	..
May, ...	..	..	..	..	..	..	..	..
June, ...	..	..	..	..	..	..	8 12 0	..
July, ...	..	..	..	..	..	..	..	100 0 0
August, ...	..	..	..	..	..	..	..	..
September, ...	..	..	..	..	..	..	..	..
October, ...	..	..	..	..	..	..	..	..
November, ...	..	..	..	..	..	..	..	..
December, ...	..	..	..	..	..	..	..	..
Total, ...	30 0 0	32′ 0 0	78 10 0	55 0 0	50 7 0	552 1 0	65 12 0	100 0 0

The author's practical experience was largely gained as the manager of several mines on the Colonia property.

4. Jamestown Belt.—North of Junction there is a band, generally called the "North Kaap," which can be followed interruptedly towards the north (Plate II.).

This ranks lower in importance than the main belt. The reefs are sparsely distributed in the valley and in the small ranges on both sides of the North Kaap river, interbedded with the talcose schist and shale strata. On the west side there is granite, and on the east hornblende rock, while frequent granite veins occur in the belt, which are in connection with the main

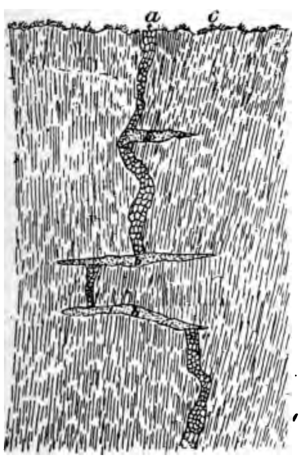


Fig. 44.—Reef in Jamestown. *a*, Reef; *b*, clay vein; *c*, talcose schists.

Fig. 45.—Reef of alluvial nature. *a*, Quartz blocks; *b*, clay and soil; *c*, talcose schists.

mass. Even in the northern part the granite can be followed right through the belt. The reefs are so disturbed by diorite dykes as to render them expensive to mine, owing to the extensive fouling and frequent changes in the dip. It is only in a few places near the main belt that the disturbance is comparatively small.

The light blue or milky quartz which occurs as blocks in a pot-clay is traversed by many broken quartz veinlets, while the reef itself is shifted out of position (Fig. 44).

The reef contains much visible gold and occasional patches of auriferous pyrites.

It runs through talcose schists, sometimes has quartzite on the hanging-wall and similar chutes to those in the main belt.

When prospecting in this belt care should be taken not to attach too much importance to the rich lodes or large bodies (pockets) found in it. The clay contains glassy quartz. As the gold is found in the loose material and not in the solid quartz, the inference is that the deposit is an alluvial one (Fig. 45).

The numerous gash veins characteristic of this belt cut through all the rocks, whether stratified or not, and consist of superficially decomposed hard blocks of slate, quartz, quartzite, and igneous rock, with the interstices filled up with clay and small pieces of quartz. It is considered to be an alluvial deposit (Fig. 46).

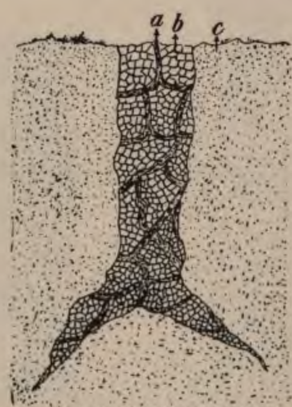


Fig. 46.—Reef in granite.—*a*, Weathered crust (the gold-bearing part); *b*, blocks of rocks; *c*, granite.

Jamestown was formerly a camp, but all that is now left of it consists of the remains of old huts. The district abounds in alluvial deposits, and, as the North Kaap river traverses it, these can be easily and economically washed for gold.

As the gash veins are in many cases rich in ore, this belt should prove a splendid field for diggers with limited means.

5. The Jamestown Gold Output.—The following lists, extracted from the reports of the Chamber of Mines at Barberton, will give some idea of the amount of gold obtained from this district:—

OUTPUT IN JAMESTOWN.

	ALBION G. MINE.				
	1889.	1890.	1892.	1893.	1895.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.
January, ...	60 0 0	268 0 0	..	34 7 7	..
February, . . .	11 16 0	123 0 0	..	50 5 0	..
March, ...	..	289 0 0	..	102 1 0	83·000
April, ...	..	339 17 0	..	..	..
May, ...	..	212 15 0	..	49 8 0	..
June, ...	..	145 0 0	..	125 6 0	..
July, ...	..	..	..	78 13 0	..
August, ...	..	..	..	148 6 0	..
September, . . .	..	..	..	134 12 0	..
October, ...	..	..	..	282 13 0	..
November, . . .	..	..	136 10 0	126 5 15	..
December, . . .	..	..	..	86 10 21	..
Total, . . .	71 16 0	1377 12 0	136 10 0	1218 7 19	83·000

	CONSORT M.			ALLUVIAL.		
	1889.	1890.	1893.	1892.	1895.	1897.
	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs.	ozs.
January, . . .	434 15 0	357 0 0	..	8 2 14	87·298	62
February, . . .	..	..	..	199 8 6	74·665	21
March, ...	533 6 0	365 19 0	..	189 7 1	74·813	21
April, ...	324 7 0	..	230 6 0	249 4 0	66·812	7
May, ...	195 6 0	..	224 10 0	188 19 0	62·937	36
June, ...	307 1 0	..	218 0 0	80 15 23	38·687	28
July, ...	303 0 0	..	269 5 0	179 18 0	84·025	34
August, . . .	276 2 12	..	167 3 0	75 4 23	82·300	7
September, . .	332 2 0	..	259 5 0	145 2 14	11·025	14
October, . . .	..	..	230 14 0	129 17 0	11·050	7
November, . .	..	..	97 9 0	195 1 21	25·400	13
December, . .	..	..	..	153 18 20	8·025	26
Total, . . .	2705 19 12	722 19 0	1696 12 0	1794 19 16	627·037	276

	NORTH SHEBA.	INDEPENDENT.		MADELINE.
	1895.	1889.	1893.	1889.
	ozs.	ozs. dwts. grs.	ozs. dwts. grs.	ozs. dwts. grs.
January, ...	..	..	..	..
February, ...	..	..	..	..
March, ...	..	..	..	..
April, ...	..	..	..	..
May, ...	..	..	..	50 0 0
June, ...	88·000	..	..	..
July, ...	..	..	..	..
August, ...	..	..	..	..
September, ...	..	..	..	..
October, ...	..	71 3 0	..	..
November, ...	..	..	50 1 0	..
December, ...	..	..	..	..
Total, ...	88·000	71 3 0	50 1 0	50 0 0

6. Kantoor or Table-Lands.—The table-lands rise high above the valley and afford a magnificent view over the country above described (Plate II.). There is a township, Kaapsche Hope or Devil's Kantoor, which at present has few inhabitants. The formation consists of coarse sandstone and shale, with the interbedded conglomerate reef, which W. H. Penning assigns to the Devonian or Old Red Sandstone—that is, to a later period than the beds already noticed.

The pebbles, which are rounded and of moderate size, are mostly quartz, but occasionally dark blue slate, set in a finely-powdered and auriferous talcose schist and sandstone, abounding in pyrites. The beds occur in gentle folds, and the gold is mostly found in the lower portion (Fig. 47).

Fig. 47.—The conglomerate and sandstone on table-lands.
a, Conglomerate ; *b*, sandstone ; *c*, granite.

The rocks in the higher districts are much exposed to the weather, so that even the hard granite and diorite boulders have a weathered crust, which in time scales off and is taken away by floods (Fig. 48). This action is especially well seen in these table-lands where cut up by ravines.

There are indications of the former presence of still higher formations, comprising (1) a thin limestone series, and (2) a group formed of conglomerate, sandstone, and shale. The uppermost one was apparently highly auriferous, judging from the numerous tabular blocks and water-worn cavernous boulders which now represent it, and from the nuggets which have been found in these cavities.

Limestone is excavated near Godwaan river station. In several

parts, as near the valley of the Crocodile river, on the Godwaan plateau, and in the Elands-spruit, all the table beds thin out or have been removed by denudation, and a shale formation with quartzite seams, resembling that in the main belt, now lies upon the granite. This abounds in auriferous quartz veins, the gold being both coarse and fine.

The rich gold-bearing reefs worked on the Godwaan plateau have a general north or south strike, a width in places of several feet, and more or less oxide of iron. There are in many parts large patches of auriferous surface soil. Gold-bearing quartz stringers, running in all directions, are widely distributed over the plateaus.

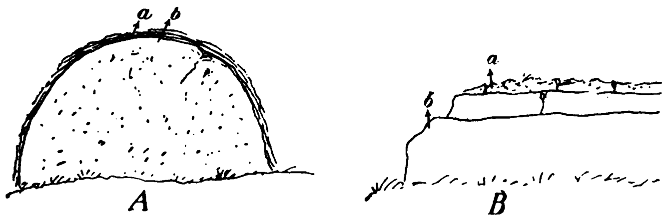


Fig. 48.—Oxidised or weathered rocks.—*A*, (*a*) crust, (*b*) granite boulder; *B*, (*a*) oxidised sandstone, (*b*) sandstone layers.

Thick alluvial deposits occur in many of the ravines, terraces, and even on the plateaus to the south-west, as also in the valleys of the rivers flowing towards the Komati, the De Kaap Valley, and Poverty Creek. The origin of this alluvial gold can be traced to the conglomerate and quartz veins on the table-lands. Unluckily transport is difficult. At Barretts Berlin the bare sandstone is covered with several inches of earth, which, even between the grass roots, was found auriferous throughout, and fair-sized nuggets were discovered there.

The table-land beds must have existed above the main belt, and perhaps even over the whole De Kaap Valley, as a horizontal decomposed sandstone formation, similar to that seen on the Kantoor, occurs on a hill at Moodies concession, where it has yielded much alluvial gold.

7. Gold Output.—The reports of the Chamber of Mines, Barberton, give the following outputs of gold derived from this table-land formation :—

OUTPUT ON THE TABLE-LANDS.

	BARRETTS BERLIN S. M.								GOETZEESTROOM ESTATE.			
	1889.	1890.	1891.	1892.	1893.	1895.	1897.	1898.*	1891.	1892.	1893.	1895.
	ozs. dwts.	ozs. dwts.	ozs. dwts.	ozs. dwts.	ozs. dwts.	ozs.	ozs.	ozs.	ozs. dwts.	ozs. dwts. grs.	ozs. dwts.	ozs.
January, . .	100 9	135 0	200 0	22 10	85 0	588·000	900	770	..	204 4 0	29 5	..
February, . .	8 0	217 8	240 0	110 4	10 0	447·400	903	800	..	253 15 0	36 2	..
March, . . .	250 0	215 0	145 5	110 0	122 4	517·000	900	510	..	234 4 1	46 0	..
April, . . .	175 0	210 0	153 15	70 0	100 0	433·450	905	735	..	247 10 0	50 0	..
May, . . .	170 0	200 0	143 0	150 0	93 0	555·000	910	670	214 10	222 12 0	42 0	..
June, . . .	70 0	195 0	128 9	66 0	..	518·000	825	650	137 15	189 15 0	..	..
July, . .	111 0	209 0	152 10	157 10	..	425·000	906	667	66 5	156 0 0	..	..
August, . .	145 0	118 10	91 7	55 0	59 3	282·250	900	837	162 11	125 10 0	..	..
September, . .	100 0	200 0	96 0	111 2	286 1	274·250	746	840	82 10	69 5 0	31 0	..
October, . .	155 0	115 15	59 0	83 8	262 3	811·500	715	884	60 10	93 12 0	53 13	124·350
November, . .	165 0	165 0	87 5	153 0	354 0	802·000	720	992	..	55 17 0	61 0	111·100
December, . .	107 0	185 0	89 2	201 0	441 10	544·500	1000	1120	..	24 5 0	63 0	..
Total, . .	1556 9	2165 13	1585 13	1289 14	1813 1	6198·350	10,330	9475	724 1	1876 9 1	412 0	235·450

* *African Review.*

8. Granite Basin or the De Kaap Valley.—Taking into consideration all the gold derived from the beds previously mentioned and from the surrounding rich fissures, great quantities of auriferous alluvial must have accumulated in this valley.

Judging from the form of the basin, the strongest floods must have rushed from west to east, broken their current near Jamestown. and turned into a narrow pass towards the Crocodile River. The finer gold would be dropped at this turn, while the coarser grains would be buried more to the north or west, at the commencement of the valley, and be found in the deeper parts near the bed rock.

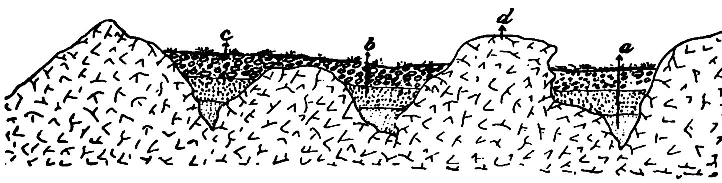


Fig. 49.—The De Kaap Basin with its alluvial deposits.—*a*, Deposits highly mineralised; *b*, coarse gravel with auriferous patches; *c*, boulders and fertile soil.

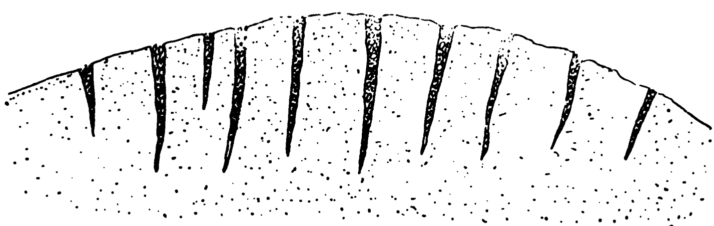


Fig. 50.—Cracks or pipes in granite filled with alluvial matter.

In the western part of the basin the granite forms conical and flat-topped hills, which are traversed by many diorite dykes, now appearing as small ranges. The valley floor is much covered with fertile soil, which probably overlies the mineral deposits (Fig. 49).

The flat-lying granite has numerous pipes, filled with gravel and hardened sedimentary material, which have the appearance of small veins. Some of them are auriferous, and the inexperienced unpractised prospector mistakes them for true veins (Fig. 50).

Concession Creek has many alluvial deposits rich in nuggets, resting in holes and on the terraces, unconformable on the older rocks. In the valleys of the Queen's or South De Kaap river and of the North De Kaap river, auriferous deposits occur with only a thin soil cap above them. I have often met with solitary gold-diggers, who, judging from the amount of deposit turned over, must have had good finds. Alluvial diggers are characterised by their preference for working alone and by their habit of not disclosing their discoveries.

9. Asbestos.—South of the Devil's Kantoor a hornblende schist formation occurs, which in parts is overlaid by the sandstone; but it is exposed near Jamestown and below Tafelkop (the highest point in this field, 6700 feet above sea level).

Fig. 51.—Asbestos.—*a*, Two outcrops ; *b*, hornblende and serpentine rock ; *c*, pocket of asbestos.

Asbestiform serpentine has been seen in places, and below the Tafelkop it has been opened to a depth of about 100 feet. It is not easily seen, as it has the appearance of rotten wood mixed with earth. It is enclosed between two walls of serpentine rock, dipping to 50 feet at an angle of 75° to the north ; but lower down it descends perpendicularly, striking from east to west (Fig. 51).

The adjoining strata consist of beds 6 inches thick, well stratified and of medium hardness; this rock on exposure to the open air very rapidly decomposes and crumbles down. Both sides of the walls, which alternately close and widen into pockets, are lined with long quartz-like crystals (Fig. 52).

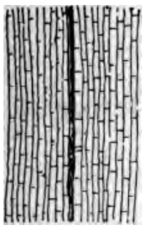


Fig. 52.—The two walls of the reef with a lining of long quartz-like crystals.

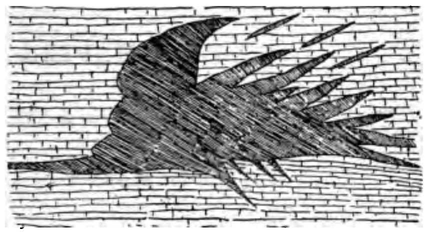


Fig. 53.—Small veins of asbestos leading to the pocket.

The more massive asbestos occurs in the pockets only. Small leaders extend into the adjoining formation; in parts they appear scarce, in others more numerous. The latter is a sign of the proximity of a pocket.

At the outer end of these leaders the fibres are very short, but lengthen towards the pocket, where many of them connect and form bodies of from ½ to 2 tons in bulk (Fig. 53). These pockets are generally from 5 to 10 feet apart, and widen as they descend. The fibre of the asbestos on the surface is of a coarse quality, but improves lower down.

CHAPTER V.

THE KOMATI AND SWAZILAND GOLDFIELDS.

1. Komati Goldfield.

The principal mining centre of the Komati Goldfield is Steynsdorp, about 30 miles, as the crow flies, south of the De Kaap Field, and immediately on the border of Swaziland.

The district round Steynsdorp is Government property, thrown open for public diggings, and surrounded by the concession farms of Swaziland and private Transvaal farms, and some that are proclaimed for the benefit of the gold seeker. The northern part of this field is called the Komati Valley. It adjoins the De Kaap Valley on the east, and, like it, consists of granite (Plate II.). Many gold-bearing lodes, pockets, and deposits have been worked on many farms, similar to those found in the De Kaap Basin.

Above it, on the south, are quartzite, slate, and schist (Swazi formation), which contain many auriferous reefs, extending to Steynsdrop and as far as Swaziland. The granite cuts the strata at several places.

This large area has been even less explored than the De Kaap; but the few places which are known give evidence that the De Kaap Belt continues westwards, and that the auriferous nature of other formations which overlie the dip of the Main Belt are similar. The latter are prospected mostly along the Komati River, where the reefs are exposed.

These properties should be easily mined, as they are within easy reach of the river, so that the large-sized quartz reefs, although they usually contain a low grade ore, will in time be profitably worked after richer reefs (if any exist) have been exhausted.

The formation here, as in the other districts noticed, is much tilted and disturbed by dykes; still many reefs can be traced for

a considerable distance. Alluvial deposits are met with along the banks and valleys of the Komati River. The country is well wooded, so that the timber required for the prospecting and starting of mines is obtained at small cost.

Many farms that were purchased, and many claims that were pegged off for mining purposes in the early days, have been repeatedly abandoned owing to the difficulties of transport, especially during the rainy season, when such roads as exist are almost impassable. Of course, as civilisation advances and population increases these difficulties will be lessened. Nearly the whole of the Komati Goldfields is low-lying country, and malaria fever is prevalent. The properties on which some prospecting has been done include—Gypsy Queen Comstock, Gypsy Queen G. M. Co., Sheba Queen Gold Exploration, Doornhock Prospecting and G. M. Co., Ltd., and others which cannot be identified owing to their names having been changed so frequently.

Gold Output.—The following table gives an idea of the outputs of some of the properties in this goldfield, selected from the official report of the Chamber of Mines at Barberton :—

OUTPUT IN KOMATI GOLDFIELD.

	GYPSY QUEEN COMSTOCK.			GYPSY QUEEN G. M. CO.					
	1891.			1891.			1892.		
	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.
January,		..			...		48	2	15
February,		...			...		60	0	0
March,		...			...		25	0	0
April,		...			...			...	
May,		...			...			...	
June,		...			...			...	
July,		...		21	18	21		...	
August,		...		143	0	0		...	
September,		...		50	8	12		...	
October,	50	19	4	17	3	12		...	
November,		...			...			...	
December,		...		56	14	0		...	

2. Swaziland Goldfield.

There is little to say about these fields as they repeat the features of those already mentioned. The Swazi schists repose on, and are uptilted by, the granite; there are small leaders and large reefs as in the quartz reef of the De Kaap; and the auriferous belts are likewise traceable through the rough mountainous country.

The area prospected comprises the large bodies of reefs south of Komati and about 12 miles from Steynsdorp. The properties acquired are mostly concessions extending over areas of many thousand acres.

Gold Output.—The following outputs are taken from the report of the Chamber of Mines at Barberton:—

OUTPUT IN SWAZILAND.

	HENDERSON & FORBES.		FORBES REEF G. M. C.									HORO CONCESSION.				PIGG'S PEAK G. M. CO.					
	1891.		1891.			1892.			1893.			1891.		1892.		1890.	1891.		1892.	1897.*	1898.*
	ozs	dwts.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	grs.	ozs.	dwts.	ozs.	dwts.	ozs.	ozs.	dwts.	ozs.	ozs.	ozs.
January,	...		575	0	0	129	8	15	141	5	15	...		228	0	...	930	0	90	...	732
February,	...		356	0	0	...			101	3	12	...		230	0	...	380	15	...	...	582
March,	...		535	0	0	523	3	22	128	0	0	...		225	0	...	321	7	...	...	530
April,	...		92	0	0	447	10	19	160	8	11	...		212	0	...	...		...	...	682
May,	...		40	0	0	283	0	0	355	9	15	...		297	0	...	...		...	...	900
June,	...		48	0	0	298	7	0	234	14	3	...		...		...	...		...	568	525
July,	...		...			304	8	19	348	3	19	...		270	0	...	...		...	473	842
August,	...		75	3	23	311	14	14	343	3	13	208	0	...		...	...		...	629	880
September,	17	10	189	13	3	225	11	20	314	18	9	248	7	244	0	...	...		...	585	770
October,	...		212	0	0	311	14	0	260	13	0	214	0	183	10	1595	...		...	697	874
November,	...		130	0	0	314	0	0	304	8	0	186	0	154	0	1280	...		...	815	800
December,	...		...			272	1	14	195	19	10	303	0	254	0	...	54	0	...	529	702
Total,	17	10	2252	17	2	3421	1	3	2888	7	11	1159	7	2297	10	2875	1686	2	90	4296	8819

The discovery of coal in this district will greatly enhance its value as a gold-producing area.

* *African Review.*

CHAPTER VI.

GOLD MINING ON A SMALL SCALE.

THE yield of gold on Moodies in the early days was :— *

			Tonnage.			Ozs.	Dwts.	Grs.
1884,	December,		...			95	1	2
1885,	January,		...			165	16	0
	February,		...			431	8	16
	March,		...			201	13	4
	April,		...			155	10	0
	May,		...			342	11	5
	June,		...			272	12	3
	July,		...			317	3	23
	August,		...			385	6	2
	September,		...			853	14	0
	October,		...			1600	1	6
	November,		...			819	17	16
	December,		...			838	2	16
		Say	4467	0	0	6478	17	21
1886,	January,		597	10	0	1280	3	19
	February,		648	0	0	1103	18	1
	March,		790	0	0	1260	9	19
	April,		664	0	0	900	15	4
	May,		684	0	0	915	16	1
	June,		450	0	0	680	14	8
	July,		458	10	0	598	14	11
	August,		317	1	0	675	10	23
	September,		119	15	0	247	19	9
	October,		189	0	0	292	9	19
	November,		349	0	0	558	2	28
	December,		656	0	0	922	13	11
1887,	January,		497	0	0	675	11	11
	February,		482	15	0	392	18	6
	March,		497	0	0	427	4	5
	April,		472	10	0	471	3	6
			7872	1	0	11,404	5	14

For the above table I am indebted to that valuable publication *Golden South Africa* by G. B. Mathers, F.R.G.S.

* Estimated value of alluvial gold found, £8000.

The outputs in this table show an average yield of 29 dwts. to the ton of ore. This high figure cannot be taken as the average yield to-day; as the earlier prospectors were able to mine the richest outcrops by means of long shallow trenches having a depth of about 20 feet, and as these outcrops were highly decomposed and easy to work, the general result would be a high average output. Later on, with deeper trenches, more blasting, and a larger proportion of low-grade ore, the general average yield would gradually diminish from 10 to 18 dwts. per ton of 2000 lbs. weight.

Of course, by working to-day on a small scale and selecting the richest ore, the average yield might be increased to over 20 dwts. Therefore, it is advisable in making good ground payable not to establish too big a concern, except where the chutes are very large or very closely situated, so that the transport expenses from the mine to the battery may not be unduly great. A five-stamp battery should be ample for most small concerns with limited means, and would suffice for developing the ground and proving if it was worth the erection of more extensive machinery. The outlay would be about as follows:—

A five-stamp mill, erected complete in the Barberton district, would cost about £2500.* Suppose such a battery has been erected, the property well opened up, and a good amount of ore ready, say about 100 or 200 tons, at an average value of 15 dwts. per ton, the monthly outlay and profits should be as follows:—

Working Expenses in Mine—	
One miner,	£20 0 0
Wages for 15 Kaffirs, including board,	40 0 0
Expenses in the Battery—	
One amalgamator,	£20 0 0
Wages for 2 Kaffirs, including board,	5 0 0
Tools and Requirements—	
Coal, about 30 tons, at 16s.,	£24 0 0
Hammer, drills, and repairs,	5 0 0
Explosives,	5 0 0
Quicksilver,	1 10 0
Sundries,	8 0 0
Total monthly expenses,	£128 10 0

Each stamp crushes, say, 1 ton in twenty-four hours, at a speed of 75 blows per minute. Five stamps crush 5 tons a day.

* Estimate given by Fraser & Chalmers, Ltd.

Five tons per day in a month of 26 working days amount to 130 tons. Taking the average value of 15 dwts. per ton, the result would be $130 \times 15 = 1950$ dwts, = 97 ozs. 10 dwts. One ounce of gold is usually reckoned to be worth £3 10s.

The monthly output of 97 ozs. 10 dwts. would be worth	£341 5 0
Monthly expenses, as above, ...	128 10 0
The monthly profit, . . .	£212 15 0

In addition to the above, there are, of course, a few extra expenses such as the cost of license for mining rights on the claims, which depends on the size of the ground held; and percentage of profit, whatever it may be, payable to the Government. For economical working it is wise not to have too large a property. Holding extensive mining rights becomes purely a speculation.

Native Labour for the Mines.

The mining work requiring little skill is performed entirely by the black man (Kaffir). He is accustomed to an easy and indolent life in his own location or Kraal, and is therefore not readily induced to seek for work at a distance. When engaged his behaviour is not at all conscientious, and he cares little how he occupies his working time. He will leave his employer as soon as he is tired of work, when all persuasion is of no avail; in this mood he will even forego his wages. He seems to be more contented when in service on land estates or farms, where the conditions of payment are more congenial to his taste. They are usually as follows:—Instead of money he is either allotted a piece of land upon which he can live with his family and cultivate what he likes during his stay, or live stock is the reward. There are many instances where a native has become the owner of a large number of cattle during his long service. This is the height of his ambition.

It is very necessary for a new comer to understand the handling of natives, who do most of the heavy work in this country. If properly treated they make good and useful servants, easy to teach and willing to learn; but in so many cases they are spoilt by the stranger, who, unused to their manners and customs, assumes a too familiar attitude towards them and plays or jokes with them. They, childlike, always expect this afterwards, lose respect for their employer and fail to realise the importance of the work entrusted to them.

Consequently one must be strict; but harsh treatment is by no means necessary. The arrangements of hire should be carefully made beforehand and fulfilled to the very letter. The average wages are from 30s. to 60s. per month. It is usual to supply the food, which consists generally of mealie meal (Indian corn) during the week and one pound of meat on Saturday, all of which he prefers to cook for himself. For shelter he needs little, being content to roll up in a blanket under any covering. If there be no accommodation ready he will make a primitive hut out of long pliable reeds or branches and grass, provided they are obtainable in the neighbourhood.

CHAPTER VII.

NECESSITIES FOR EXPLORATION IN WILD AND UNHEALTHY DISTRICTS.

The explorer in districts where no accommodation is available should be careful to provide himself with all necessary equipments, such as tents, waterproof sleeping-bags, blankets, and food. Some knowledge of cures against poisonous bites and stings should be gained before undertaking expeditions to lonely spots, also against malaria fever and other sicknesses peculiar to the country. The best mode of travelling is with ox-waggon or donkeys, or, failing these, Kaffirs can even be employed to carry the outfit. Stations or camps can be pitched wherever favourable, whence all operations can proceed and to which return can always be made after a day's exploration. Great caution is essential in the choosing of sleeping places, it being best always to select these well above river beds, where the heavy mists usually hang, for the influence of malaria is more active in low parts near the ground, especially where the soil has been dug up and after the sun has gone down.

Heights above 4000 feet are generally considered to be free from malaria; persons affected with this disease in such altitudes have us ually contracted it in the lower country, it may be years prior to the disease becoming manifest. People suffering from fever in the low country must not move to the high land, on account of the sudden change of temperature. This is especially the case in the De Kaap Valley towards Jamestown and the Crocodile river, the Klein Letaba, Murchison Range, and Pilgrim's Rest. It is also advisable never to sit under shady trees or upon cold stones, as the heated system gets chilled and dangerous sickness is likely to ensue. Wet clothes should be changed at once, and, if possible, only boiled water drunk. Generally speaking, the person who is constantly ɑtive, and who has led, and continues to lead, a regular temrate life, will maintain his health even in those parts where

the fever is known to be prevalent. The time from November to April (called the fever time) is particularly unhealthy for horses and mules, and few can stand much work during this period. The "horse-sickness," simply so-called locally, is, one may say, a pest through which thousands of animals are lost yearly, especially in low-lying fields. From 4000 to 6000 feet above sea level is generally reckoned to be healthy for these animals. Where, however, the country gets more civilised, this disease has a tendency to disappear. No real cure has been found, though there are some who recover from the sickness, which may be due either to some so-called remedy or to the work of nature.

The animals which have recovered from this disease are called "salted," and are, in consequence, generally higher in value; but a slight relapse every year, in the corresponding month to that when the disease formerly occurred, must be expected, and the animal should be rested at that time. Many horses die through carelessness during this period. They should always be well stabled at night and not brought out in the morning till the heavy dews are all evaporated. The signs of the disease are only apparent and dangerous after the fifth day.

It is generally recognised that donkeys, although very slow, are more useful in this country. These animals are not particular as to the quality of their food, they are much more hardy, and less liable to sicknesses than horses. In the wilder parts, such as Lows Creek in Crocodile River Valley and other low-lying districts, the poisonous tsetze fly (*Glossina morsitans*) abounds; but it occupies only strip-like areas rarely higher than 3000 feet above sea level.

Prospecting in such infested districts is best accomplished on foot, accompanied by Kaffir carriers, for all animals, except wild game (especially buffalo), are very liable to be fatally attacked.

CHAPTER VIII.

HINTS FOR THE DEVELOPMENT OF THE DE KAAP, KOMATI, AND SWAZILAND GOLDFIELDS.

ONE naturally asks why goldfields so wealthy as these are should be in such a backward state? There are four reasons for it, viz. :—(1) The difficulties and hardships of the earlier days; (2) the first boom and subsequent slump; (3) the discovery of the Witwatersrand Goldfield; (4) insufficient prospecting.

The first gold-seekers, owing to the great hardships they had to endure and the difficulties to be surmounted in travelling over such mountainous country, were forced to neglect much of their prospecting work, as all their energies were expended in the struggle for mere existence. After a few encouraging discoveries had been made a great boom ensued, and prospectors began to find their work "inconvenient," for money was given with so free a hand to anyone who would peg out ground, no matter what it contained, that they preferred to earn their living thus easily. Realising later that this was done in excitement, and that heavy sums were lost, there was a falling off in the investments, a sudden slump ensued, and most of the prospectors went to the healthier and rising Witwatersrand Goldfield, so that the bulk of the remaining inhabitants were either store-keepers, officials, or farmers.

In 1895 there was a revival of interest in these fields, but the baneful effects of the Jameson Raid made the people wary of investing, and since then little progress has been made. The following particulars, showing the great prospective value of these goldfields are worth consideration :—

(1) The discoveries of gold that have been made are thus notified in the journals mentioned :—

In Dr. A. Petermann's *Mittheilungen* for 1879 it is reported that the South African Goldfields

From 1866 to 1870 yielded gold to the value of					£23,000
" 1873 " 1874	"	"	"		103,416
In 1874	"	"	"		250,766
" 1875	"	"	"		185,726

The Volkstem says:—In 1874 Mr. Forster has taken out of his claim one nugget weighing 87 ounces, and Mr. Dickson one nugget weighing 60 ounces; and that, in 1875, nuggets have been found, having the weights mentioned in ounces, by C. Russel Lilley & Co., 213; Cameron, 69; Holland, 29; M'Kemie, 57; and (names unknown) 47.

The Goldfield Mercury gives the following finds of nuggets:—September 11, 1874, Messrs. Stibbs and Ross, 48 ounces; December 18, Chartterton and Hodgson, 69 ounces; January 8, 1875, in Pilgrim's Rest, 96 ounces; January 27, same place, 57 ounces.

The Eastern Province Herald reports that, in 1875, nuggets were sent to Port-Elizabeth, principally from Pilgrim's Rest, including some weighing 4½ lbs. pure gold, which had an aggregate weight of 1680 ounces.

In the Devil's Kantoor nuggets have been found from time to time; the gold in one twelvemonth weighed 55 ounces, in another two-month period 96 ounces, while one nugget had a weight of 84 ounces.

This shows that gold nuggets of fine quality and of large size have been obtained from places which have, perhaps, been long since lost sight of.

(2) The alluvial and other finds mentioned in the yearly outputs attracted the attention of investors, who soon became property owners.

(3) Although the properties changed from one owner to another, they were never abandoned.

(4) The auriferous lines traceable for many miles, on which there are properties of undoubted value, including, as they do, the undermentioned mines:—Abbott, Agnes Block, Alpine, Albion, Barrett's Berlin, Blue Rock, Belfast, Bellevue, Cornstock, Consort, Constance Atlas, City of Grahamstown, Clutha, Daisy Reef, Doornhock (Steynsdorp district), Durham Allan, Eagle's Nest, East Sheba Reef, Figaro, Florence Reef, Forbes Reef, Great Scot, Ivy Leaf, Joe's Reef, Jeppes Concession, Kimberley Sheba, Kololondo Concession, Liverpool Block, Macongwa Block (Low's Creek), Moodies Fortuna, Moodies Homestake, Moodies Golden Hill, Mount Morgan, New Brighton, New Scotsman, North Star, North Sheba, Oratava, Oriental, Pioneer, Pigg's Peak, Royal Sheba, Sheba Mine, Sheba Hill, Sheba Queen, Sheba West, Southern Cross, Tiger Trap, Thistle, Thomas, Ulundi, Unuvoti, United Ivy, Union, Walhalla, Weltevreden Farm, Weltevreden Estate, Woodstock, Woodbine, Victoria Hill, Zwaart Kopjes, Zwaart Kopjes Low Level, Zwaart Kopjes West, and others.

(5) The few regularly gold-producing mines given in the tables on pp. 46-52, such as Sheba, Ivy, and Barrett's Berlin, are all due to good management by the energetic investor, proving that gold is obtainable at deep levels.

These considerations lead to the conclusion that these discoveries, rich and poor, from year to year, and spread over only a certain area or line, are the indicators and forerunners of the much larger treasure that has yet to be found.

That little exploration has been done, the recent discovery in 1895 of Zwaart Kopjes, in the immediate neighbourhood of the Sheba, gives evidence. No doubt many prospectors and employees of the Sheba mine had frequently walked over this very ground without noticing its remarkable golden outcrop.

Again, in 1897, another rich strike was made above the Moodies Fortuna mine, close to a footpath ascending the hill; this conspicuous outcrop also must often have been passed by. The author has had many opportunities of visiting most of the properties where good chutes, both in quality and size, were exposed at a low level, and he sees no reason why, if economical means are used, profitable concerns may not be organised in the future. This will no doubt come to pass when mining material can be obtained at more reasonable prices than heretofore, and honest energetic work has taken the place of speculation.

An examination of the debris from many crushings and of the ore crushed on properties that are now at a standstill shows that the mining and testing was only artificially done, as the auriferous quartz is often found to be mixed with "dead" country rock, which, if carefully sorted, would make the output more satisfactory, and save time in the unnecessary crushing of rock. The tailings are noticed, by panning, to be still rich in gold, showing that testing has not been fully carried out.

CHAPTER IX.

THE LYDENBURG GOLDFIELD.

(CAPE FORMATION.)

NORTH of the Devil's Kantoor the table-lands are met with, forming single mountains and extensive plateaus as far as Lydenburg, a town established in the year 1847 and surrounded by mountains about 4706 feet above sea level.

Eastwards from this town the Mauchberg (7177 feet) is well in sight.

The formation corresponds to that of the De Kaap table-lands and may be looked upon as a continuation of this. The upper and lower sandstone and shale formation, with their conglomerate beds, are often separated by dolomite; these beds rest horizontally on tilted schist, beneath which the granite is clearly seen in places (Fig. 54).

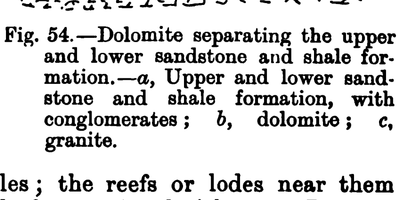


Fig. 54.—Dolomite separating the upper and lower sandstone and shale formation.—*a*, Upper and lower sandstone and shale formation, with conglomerates; *b*, dolomite; *c*, granite.

The lower sandstone and conglomerate are often rich in gold, and often have a strong resemblance to the younger strata of the Witwatersrand Goldfield.

Diorite dykes are met with everywhere, and the strata are tilted to all angles; the reefs or lodes near them are often of unusual size and of exceptional richness. In some localities reefs rest upon the diorite, in which case a few black shale layers form the foot-wall, while in others the lodes occur in the dykes themselves and are also gold-bearing (Fig. 55).

Several of the thin auriferous quartz leaders or stringers which traverse the shale and sandstone formation, or which are

intruded between the beds, sometimes unite and form a larger body. The beds are vertical, inclined, horizontal, undulating, or contorted; in parts the shale is sparsely interveined with sandstone, in others the sandstone is more prominent.

There is great variation in the formations and auriferous lodes occurring in different localities.

Around the Lydenburg township a shale formation with, occasionally, sandstone dips slightly to the west, and diorite

Fig. 55.—Quartz reef resting upon diorite.—*a*, Quartz reef; *b*, diorite; *c*, shale; *d*, black shale.

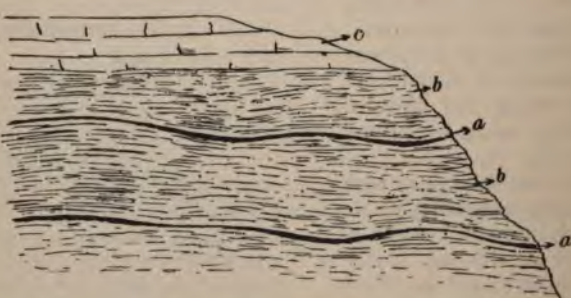


Fig. 56.—Quartz veins in shale, overlaid by sandstone.—*a*, Quartz veins; *b*, shale; *c*, sandstone.

dykes break through the beds in an almost vertical position, in which an auriferous quartz reef crops out with a strike about north-north-east. On the rocky tabular mountain summits, near the Pilgrim's Rest Creek, the upper and lower sandstone and shale formation can be well seen.

Irrespective of the many auriferous veins, the sandstone is itself gold-bearing in places; when this is the case, the overlying

beds often consist of quartzite or of alternate thin layers of limestone and quartzite. The auriferous sandstone and lodes are often associated with greenstone, and, as all are much weathered, the ore is easily mined.

In the same neighbourhood the beds are occasionally disturbed, as though they had been shifted or had slipped, and the undulation in places is more pronounced. North-east of Lydenburg, on the rocky edges of hills along the Spekboom river, the undulation in shale and sandstone is again noticeable, and there are several auriferous quartz veins from 1 inch to 2 feet in thickness (Fig. 56).

Near Blyde river are two small gold-bearing quartz veins, one of which occurs below the conglomerate and sandstone, near to the dolomite, while the other is above them and close to the shale beds; both contain sandy quartz with much sulphide of iron, carrying, roughly, 20 dwts. of gold per ton of 2000 lbs. weight (Fig. 57).

At the Spitzkop Mac-Waterfall Farm digging there are similar lodes and beds.

The table-lands continue to the north, but on the west they disappear under the coal-bearing formation; towards the east the country slopes rapidly downwards thousands of feet into the low country.

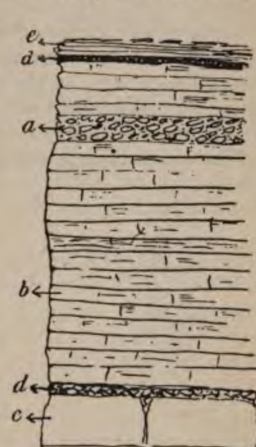


Fig. 57.—Section of sandstone and conglomerate formation.—*a*, Conglomerate; *b*, sandstone; *c*, limestone; *d*, auriferous lodes; *e*, shale beds.

Many of the localities in the Lydenburg Goldfield have become popularly known through the discovery of auriferous deposits.

Extensive auriferous deposits of considerable thickness have been, and may still be, found in terraces, valleys, and slopes of river banks in the following well-known localities:—Spitzkop and Waterfall Farms, Pilgrim's Rest Creek, Rose Hill, Cray's Creek, Columba Hill, Rotunda Creek, Blyde River, Oreghstad Valley, and around various parts of the township of Lydenburg. These alluvial gold patches are often situated above the level at which water can be brought up for practical purposes; hence the expenses in most cases are greater than the value of the

gold contained in the deposits. There can be no doubt that the gold in the alluvial valley deposits has been derived from the lodes, reefs, and stringers which existed in those portions of the table-lands that have been removed by denudation.

The vast extent of these deposits and the profitableness of many of the gold finds of the past make it very probable that these are but samples of what will be found by future prospectors. Many concession properties of large extent, known to be of great value, still await development.

The biggest nugget found in this district weighed, it is said, 215 ounces. It is impossible to accurately estimate the yield of alluvial diggings, as the official returns are incomplete; but, so far as reported, the yield is stated to have been about £1,000,000 (one million pounds) sterling.

The approximate output of reef and alluvial gold was as follows:—

1889, ...	13,050 ounces.
1891, ...	23,803 ,,
1892, ...	24,092 ,,
1893, ...	29,329 ,,
1894, ...	60,506 ,,
1895, ...	60,275 ,,
1896, ...	50,380 ,,

CHAPTER X.

ZOUTPANSBERG AND LOW COUNTRY GOLDFIELDS.

Following the Drachensberg Range northwards the succession of the goldfields is—Murchison Range or Selatie Goldfield, Houtboschberg and Malatopo Goldfield, and Klein Letaba Goldfield or the Spelunken. (The Zoutpansberg district covers about 25,000 square miles, in which the "proclaimed goldfields" consist of about 3564 square miles.)

It is recognised that these fields continue into Mashonaland.*

The formation of these fields is granite underlying crystalline schists, which extend for a considerable distance in an easterly and westerly direction. The auriferous rocks consist of mica, chlorite, hornblende, and talc schists, and sometimes of sandstone. Long stretches of exposed granite intervene between each field (Plate IV.). The schists form undulating belts, and appear on the east side of the Drachensberg Mountains, sloping downwards towards the low country.

In the west of the Murchison Range, especially in the neighbourhood of Hænersburg, the table-lands (with their conglomerate reefs) are again noticed at a height of about 4500 feet; it is from them that the alluvial deposits found in the creeks and valleys below have been derived. The conglomerate reefs are interbedded between sandstone layers (Plate IX.).

1. The Selatie Goldfield.—The Murchison Range, generally speaking, is divided into two mountain chains, one called the Murchison and the other the Spitzkop, running almost parallel with each other in an east-north-east direction. Dykes and faults are common; but the disturbance seems to have been greater in the western part of the range, close to the Drachensberg Mountain, than in the southern, although they are to be seen in all parts of the formation; they are the cause of the great variations in the reef. The strata dip 60° to 80°, and

* *The Goldfields of Mashonaland*, by A. R. Sawyer, 1894.

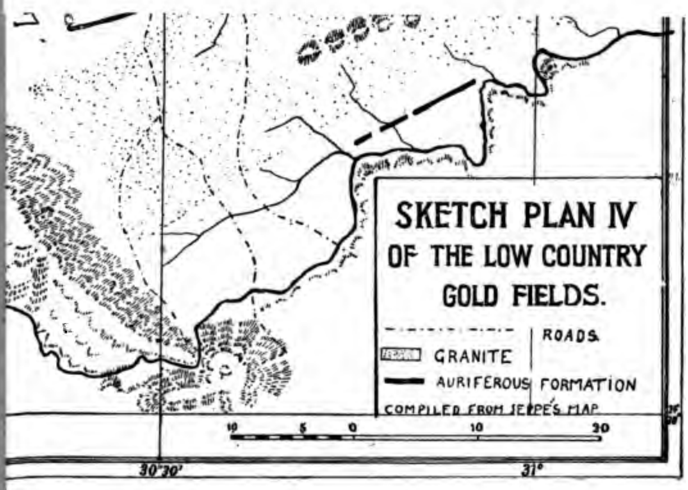
are in places contorted. There are some three or five auriferous reefs (fissure veins) in the formation which follow the direction of the range.

Most of the reefs have been prospected along the strike; the southern reef-lines occur partly as large quartz bodies, and partly as split up reefs or leaders. On the whole they are similar to those in the De Kaap Goldfield. The reefs vary from 2 inches to 20 feet in width, and give an average yield of 12 dwts. of gold per ton of rock. The quartz is coarse grained and of a pale-yellow hue.

In some instances they occur in talc schists, when coarse gold grains and visible gold are observed on the flat surfaces of quartz or schists, giving them the appearance of having been painted. Some lodes contain much refractory mineral, such as copper pyrites and iron pyrites. Southwards from the Murchison Range, north of the Olifants river, another parallel belt traverses the country; it occurs in the same formation, but is more faulted and more dislocated by dykes. It contains several gold-bearing quartz reefs. A noticeable feature is the appearance of antimony ore in the quartz. This gives to the reef a yellow decomposed look, but the antimony ore generally disappears, as in the De Kaap valley, when the reef is followed downwards.

In this discoloured reef matter coarse gold particles often occur. In places the lodes combine into large bodies, while in others they are represented by many small stringers. Their strike is parallel to the range. The hanging- and foot-walls are usually well defined, and in most cases vertical. The average gold content is about 15 dwts. per ton. The Melati and Selatie rivers run partly in the same direction as the Murchison Range, and give a water supply which is ample for mining purposes during the wet season, but somewhat precarious at other times. There is plenty of timber in this part of the country, so that the facilities for working are generally excellent. When the Selatie railway has been completed, supplies will be readily obtainable, and there will be a better chance of developing this field into a good gold-producing district. North of these fields there is a long stretch of granite country, with here and there inclined beds formed of materials brought down from the higher mountains around. The portion between the Groot Letaba river and the Malatopo river is auriferous, and is called the Malatopo Goldfields.

The reefs here occur in granite; they are very promising on 'e surface, but pinch out lower down, like the reefs of the


SKETCH PLAN IV
OF THE LOW COUNTRY
GOLD FIELDS.
ROADS.
GRANITE
AURIFEROUS FORMATION
COMPILED FROM JEPPE'S MAP
10
5
0
10
20
30°30'
31°

V.

De Kaap Basin. The alluvial deposits will probably be found to contain much gold. Facilities for working here are favourable.

2. Woodbushberg Goldfield.—South-west of this granite come the Woodbushberg Goldfields, with Hænertsburg in the centre. The granite rises to 2000 feet, and supports a quartzite. Gold-bearing veins, of a sandy nature and varying appearance, are often met with in it, as also reticulated veins, carrying rich and poor gold, where the reef is harder. Very little prospecting has been done here. It is probable that these deposits are the relics of the table-lands which once existed here as a continuation of those seen further south. Copper, as also mica of good quality and in large quantities, are obtainable in this neighbourhood.

3. The Klein Letaba Goldfield.—Between the Klein Letaba river and Lebvubi or Levubo river lies the Klein Letaba Goldfield. The Sutherland Hills here are partly formed by schists, traceable as a belt extending eastwards for many miles, and containing several gold-bearing quartz reefs. In summer the rocks are covered by the long grass, which makes searching difficult for prospectors. The undulating course causes the reef to converge and diverge, forming narrow and widely-spread series of roughly-parallel lodes, the lie of which varies from the vertical to a hade of 40° N. The lodes are from 1 inch to 6 feet in width, and have well defined walls. Pockets 15 feet in width are of frequent occurrence, while the chutes are generally from 100 feet to 600 feet long in the horizontal direction. Near the greenstone, which often appears, much visible gold is noticeable. The surface mining up to now shows that the reef either widens or thins (often to nothing), and in places appears to be in an eruptive state, where little strings or seams only can be seen. The quartz is fine grained, of bluish-grey colour, and contains much copper pyrites and sulphide of iron, together with the gold. On the outcrops the gold is found to be rich and patchy, but lower down it is more uniformly distributed, and averages less, as is mostly the case in quartz-bearing strata. The general average yield of these fields would not exceed 18 dwts. of gold per ton of rock.

On the Lebvubi river many auriferous alluvial deposits exist. As far north even as the high country of the Zoutpansberg, about 6000 feet above the sea level, gold-bearing lodes are found; but, on the whole, these northern goldfields have been little explored, owing to the disturbed condition of the native tribes,

especially those in the high Magato Mountains. From Pietersburg, the chief town of this northern district, the goldfields north-east of the town can be reached by coach. This portion has a great future before it, as it is not only rich in minerals of all kinds, but is the most fertile part of the whole Transvaal (see *Agriculture*). The mountains, which afford a healthy abode for settlers, whose work may be in the valleys below, are so situated that they protect great tracts of fertile lands from any unfavourable winds, and allow coffee, tea, sugar-cane, oranges, citron, bananas, and other tropical products to be cultivated in large quantities, which will probably prove a very lucrative pursuit in the future. This important country is sufficiently well watered, even in the driest season, by the Lebvubi river and many smaller streams, for all agricultural and mining purposes. The ravines and slopes on the mountains and all the low country are generally much wooded, so that there is plenty of timber for mining.

Between the Magato Mountain and Blauwberg a large salt pan is situated, after which Zoutpansberg (Zout = salt) is named, where quantities of salt can be obtained.

Very few excavations have been made in these low country goldfields; however, as time goes on, and experienced prospectors and mining men come in greater numbers, their intrinsic value will be thoroughly investigated and laid bare.

4. Marabasstad Goldfield.—This goldfield comprises the areas around Ersteling, north of Makaapaanspoort; Smithdorp, situated on a hill on the west about 4750 feet above sea level; and Marabasstad on the north, about 10 miles south of Pietersburg, where the railway line (Pretoria-Pietersburg) passes. The first reef mining in the Transvaal was started in this field, at Ersteling, which resulted in a rush in 1872.

The schistic formation existing there takes a north-east and south-west direction, and can be followed along the mountain ranges. Reefs are exposed from Ersteling towards Smithsdorp through several properties. They also run parallel to each other, and have a general dip of from 60° to 75° to the south. Of course, here, as in other fields, the inclined strata are disturbed, and have a north and south strike.

The thickness of the reef varies from 1 inch to 4 feet, and the yield is from 3 dwts. to 2 ozs. of free gold per ton of rock.

East of Smithdorp and west of Marabasstad the granite reappears, and has many rich gold-bearing veins which pinch out, as is generally the case in this rock.

CHAPTER XI.

THE WITWATERSRAND GOLDFIELD.

THIS great gold-producing district is an elevated country about 5000 feet to 6000 feet above sea level. The principal mining centre is Johannesburg (5700 feet), which has rapidly grown to be the largest town in South Africa.

This goldfield consists of private farms, which were thrown open for public diggings in 1886, soon after the gold was discovered. The highest portion north of the Witwatersrand Goldfield is formed of low hill ranges, running in an easterly and westerly direction, and is the watershed of a greater portion of the Transvaal, the largest rivers—the Limpopo and Vaal—having their sources in it. The ranges, chiefly formed of the tilted shale and sandstone beds, overlie the upheaved granite, which, in parts, is exposed for stretches of 20 miles. The conglomerate reefs on the south side of the exposed granitic area dip to the south at angles ranging from 30° to 60°, but, as practical experience has shown, the beds have a flatter position when met with in the greater depths.

They are traceable over a very large area, but the outcrop has been chiefly studied in the Witwatersrand between Boksburg and Krugersdorp, in an easterly and westerly direction; and in a northerly and southerly direction from Boksburg on the east, interruptedly, to Heidelberg, and across the Vaal river; and from Krugersdorp on the west to Randfontein, Potchefstroom, and Klerksdorp, including the series of beds at Venterskroom, which bear a resemblance to the above, and strike again east and west. This forms, approximately, a circle, wherein the strata dip to the centre, apparently in the shape of a basin. Many instances show that possibly the beds have an undulating dip, and may appear as outcrops in various places (see Plate V.).

The surface of the ground follows the contour of the granite. The Witwatersrand granite rises as a strip (running east and west) to the enormous height of 6000 feet. The strata lying

upon it consequently dip at various angles to the south on one side and to the north on the other.

On the extreme east and west of the granite strip the basement rock is covered by the newer deposits, and the strike of the outcrops is from north to south.

The newer strata, comprising the sandstone and shale with their conglomerate beds, cover all the more deeply-seated portions of the granite. This group is succeeded by the Black Reef series, the materials of which have probably been derived from the former continuations of the older underlying beds; an inference which is supported by the fact that there are outliers of these older beds still existing in the higher districts, while in other places (as may be frequently seen in the outcropping Witwatersrand beds around) they are covered extensively by dolomite and quartzite.

Fig 58.—Hospital Hill shale.

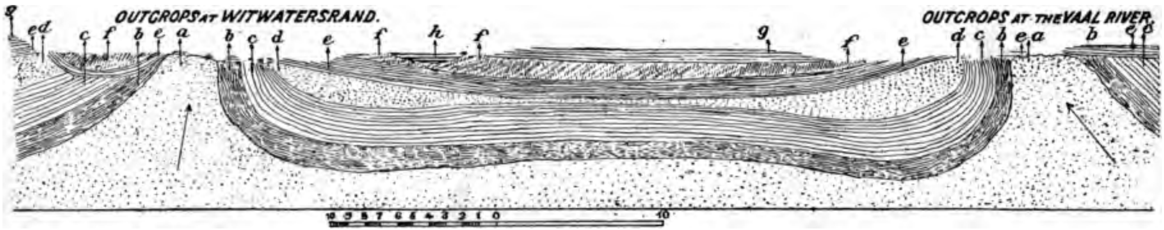
In several localities the Karoo formation, with its coal seams, appears above the Black Reef series. The varying positions of the stratified beds may be attributed to the action of the granite in forcing the beds upwards towards the surface, so that all, or only a part of them, may be seen. (This latter is the case in many localities at Heidelberg, Venterskroom, and Klerksdorp, where the different series appearing in the Witwatersrand are only partly observable.)

The formations with the gold-bearing conglomerate reef belong, according to Dr. A. Schenck's classification, to the Cape Formation, but Prof. Mollengraff in his late publication * regards them as belonging to the upper Primary Formation.

Starting from the granite, the first overlying strata consist of

* *Neues Jahrbuch für Mineralogie*, 1900, by M. Baner, E. Hokin, and I. Liebich.

To face p. 84.



THE CONNECTION OF THE WITWATERSRAND STRATA MAY BE AS IN THE ABOVE CROSS SECTION OF THE BASIN.
FROM NORTH TO SOUTH.

a. GRANITE HAS FORCED THE BEDS TO THE SURFACE. b. SANDSTONE AND SHALE (DU PREES SERIES.) c. RED SANDSTONE (MAIN R.S. AND OTHER SERIES) d. BASALT. e. OVERLYING YOUNGER BEDS. (BLACK REEF SERIES) f. DOLOMITE. g. QUARTZITE AND SANDSTONE (MAGALIESBERG FORMATION) h. SANDSTONE AND COALSEAMS. (KAROO FORMATION.)

PLATE V.

hard red or blue shale alternating with a white quartzite or sandstone. This stratum is so conspicuous that, by its means, the associated beds can often be more readily traced. It contains oxides of iron, and appears on the surface as thin shales, with magnetite bands, and is known as the Hospital Hill shale (so-called after the hill where the Johannesburg Hospital is situated and in which this shale occurs)—(Fig. 58).

Both the shale and the quartzite bear gold veins—some of quartz, others of conglomerate nature. The outcrops of this formation can be easily seen in places, but in others one may be misled by a mixed reddish surface without stratification, or by loose boulders of quartzitic rock.

The next series having the same dip is a very wide band of red sandstone carrying several series of conglomerate reefs.

The general formation of the Witwatersrand can be divided into younger and older beds. The older dips at an angle of 15° to 90°, and immediately overlies the granite.

This comprises the following conglomerate reef series:—

1. The Du Prees Reef series.
2. The Main Reef series.
3. The Livingstone Reef series.
4. The Bird Reef series.
5. The Kimberley Reef series.
6. The Elsberg Reef series.

The younger beds, which overlie in a sheet-like form the older, are softer, and the two are separated by a strong greenstone layer. In this flat formation the Black Reef series is known to comprise from one to four reefs, some of which are quartzose and others conglomeratic. These formations, with their outcropping reef series and parallel strata, have been traced and tested for about 40 miles, from Krugersdorp on the west, passing Johannesburg, to Boksburg on the east.

The Main Reef series, on which there is a continuous line of developed mines, is easily traced by means of the buildings and machinery which occupy its whole course.

1. The Du Prees Series.—This underlies all the others, rests on the granite, and forms the frame-line of the so-called basin.

It can be traced through the following farms on the Witwatersrand:—Hartebeestfontein, Bult, Elandsfontein, Waterval, Alexandra Estate, Honeyklip, Paardeplaats (Krugersdorp), Roodekraans, Welgespruit, Weltevreden, Waterval, Braam-

fontein (Johannesburg), Doornfontein, Elandsfontein, Rietfontein, Witkopje Klipfontein, Kleinfontein, Vlakfontein.

On the west similar formations can be traced, as already remarked, towards Potchefstroom and Klerksdorp, and on the east the Heidelberg district. Of course, it is often difficult to distinguish the lines, although they generally take a parallel course. The outcrops are hidden under the surface soil, and where they are exposed, frequent intrusions of the granite and dykes, and the occurrence of faults, have greatly altered the width of the strata and reefs met with in sinking.

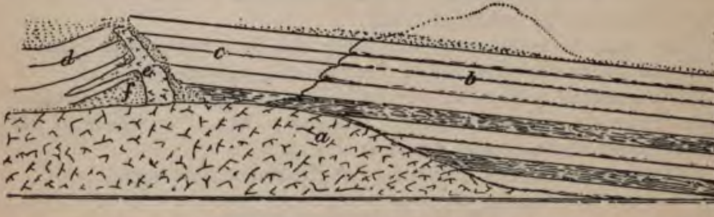


Fig. 59.—Outcrops of formation.—*a*, Granite; *b*, beds exposed on the side of a hill; *c* and *d*, overlapping of beds; *e*, dyke; *f*, soil wash.

Fig. 60.—Layers in a nearly horizontal position, showing a wide outcrop.

The varying dips account for much of this, as the same beds which have a high dip where they outcrop on the hill sides may gradually become almost horizontal at other places (Fig. 59, *b*), or the granite may pinch out some of the beds, and a higher bed may overlap on to a bed below this; or underground water may in its flow wash away the lower oxidised matter, and replace it with earth brought from the surface through the cracks originated by dykes and faults (Fig. 59, *c* and *d*).

When the formation is but slightly disturbed the stratiphically lower edges of the outcrops appear far distant from other, and are weathered to a fine edge, while the nearly surface of the stratum occupies a wide space (Fig. 60).

Again, if the granite rises more steeply, so that the strata are more tilted, the same outcrops will occur nearer to each other on the surface; therefore, to obtain the distance accurately the layers should be measured at right angles to the dip (Fig. 61).

Thus at Johannesburg, where the dip is 75°, the distance between the Hospital Hill shale and Main Reef is 6000 feet, while at Krugersdorp, 18 miles farther west, with the beds dipping 30°, the distance is 11,500 feet, almost double the width of the former. On the Rietfontein Farm, about 2½ miles north of the Driefontein Main Reef (East Rand), the Du Prees Reef series (with its four reefs) is tested and mined.

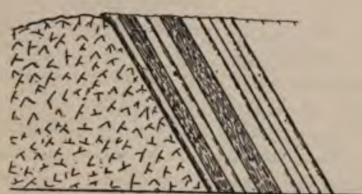


Fig. 61.—Narrow outcrop of nearly vertical strata.

Taking a section across from the granite to the Main Reef series on the south, the first reef met with is No. 1, called the North Reef, which consists of conglomerate, and varies in width from 2 inches upwards. It is enclosed by quartzite, and on the foot-wall talc schist sometimes occurs.

About a 40-feet wide quartzite formation follows, and No. 2 Reef, called Middle Reef, crops out—the most profitable body. It consists of two small leaders of conglomerate, parted by one foot of quartzite. Sometimes a quartz reef accompanies it. The conglomerate contains much pyrites, and visible gold can be frequently noticed.

No. 3 Reef, called the Stable Reef, crops out about 100 yards further south, measuring occasionally about 50 to 100 feet in width; it is a body of grits, with small seams of conglomerate on both walls, and contains in places payable quantities of ore. The last and fourth reef, called the South Reef, shows as a very wide body of conglomerate, with well-defined walls and large pebbles, but, so far, it has been found to be poor in value.

A belt of shale and quartzite formation, varying from 2000 to 3000 feet in width, separates this reef from those previously mentioned. Although the outcrops of the Du Prees Reef series

are traceable over a large portion of the Rietfontein Farm, they are in many other places covered by the surface soil, or by the more recent flat layers, which form an obstacle to prospectors all over the Witwatersrand. This covering is thicker in some places than in others, especially in the East Rand, where the coal-bearing Karroo formation dips under the Witwatersrand formation. Unfortunately, when the reef is exposed, the veins appear small, and are often so decomposed that one cannot

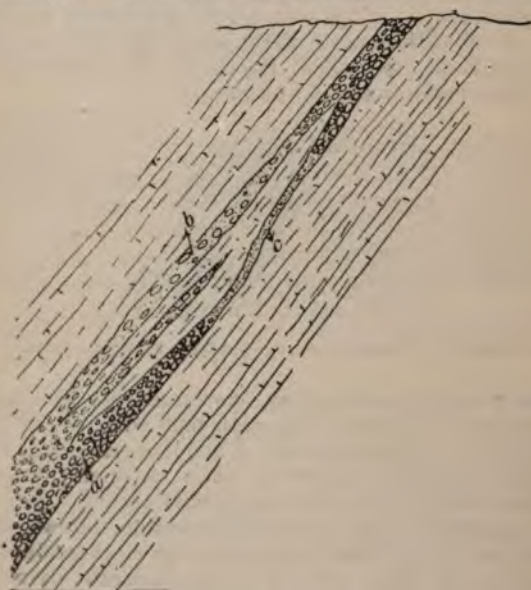


Fig. 62.—Transition from conglomerate to sandstone.—*a*, Largest pebbles on the foot-wall; *b*, pebbles become more widely separated; *c*, pebbles absent.

distinguish them from the country rock. The slate and quartzite are in places much honeycombed with rich gold, which is indicative of the presence of a reef close by. In the Du Prees series, the conglomerate reefs are often more numerous than, and different in character from, those situated on the Rietfontein farm.

The pebbles are generally smaller in the northern than in the southern conglomerate, the veins vary much in size and in distance from each other, and the dips differ considerably,

especially in the neighbourhood of the granite and dykes. The pebbles which do not contain gold consist of white smoky quartz in place of igneous rock and schist. The cement which binds the water-worn pebbles together consists of quartzite (more or less decomposed with sand) and talc schists, which latter give a silvery shine to the outcrops and bear the gold. The cement contains much iron pyrites. The pebbles are found placed in all positions; sometimes they are close together, sometimes widely scattered in a sandstone, and sometimes absent; in the last case the reef is represented by a coarse sandstone only.

In the small veins the pebbles are mostly of small size or absent altogether; then the settlement of the cementing matter is relatively richer in gold (Fig. 62).

The outcrops are much oxidised and are generally of a brownish colour, giving them the appearance of having been burnt. Agglomerates of small pebbles enveloped in a honeycombed crust showing visible gold are often found. Reefs in regular beds continue for long distances, but vary in width. Sometimes the two walls are pressed close together, and a seam can only be recognised; but they soon become further apart again.

On the Du Prees Reef series it is noticed that two reefs combine in one large body of 90 feet in width.

West of Johannesburg there are well-defined outcrops of reefs bearing in places rich gold veins. The alternate quartzite and slate are distinctly seen in the ravines or kloofs, which are cut into the steep northern slope of the Witwatersrand watershed.

The slate, which may be well followed along the slopes, has numerous small gold-bearing quartz veins.

South of this are sometimes small and sometimes wide quartzite outcrops, very much honeycombed and rich in gold. The slate forms the foot-wall and quartzite the hanging-wall. The dip is south at an angle of about 75°, and on the surface the reef appears to consist of nothing but slate, in others of nothing but quartzite, while pebbles are absent, although below the surface the continuation of the reef may contain a conglomerate which can be profitably worked.

Still further south there are several conglomerate reef outcrops formed of large pebbles, but poor in gold.

West of Krugersdorp the country is mostly covered by comparatively young beds, which are so thick that the Du Prees series has been reached in but few places.

The older and younger beds are well displayed in the western portion of the Waterval Farm. Both have rich conglomerate

reefs, and these are in close proximity on a steep hillside, where the country generally has a gradual slope (Fig. 63, *a*, *b*, *c*, *d*, *i*).

The upper formation occurs in horizontal beds, forming patches spread far over the country to the south, in which reefs have been found. The hanging-wall consists of thick layers of quartzite, and the foot-wall of blackish slate, about 1 to 2 inches thick, carrying rich gold. Under this a seam of reddish clay-like matter accompanies the reef, intermixed with much igneous rock.

The conglomerate is from 1 inch to 3 feet wide, and is most auriferous in strips or chutes striking from east to west. At the flats between the hills on the west, limestone is the general formation, under which the younger beds disappear. The pebbles are well rolled, much oxidised, and have a soft chalky

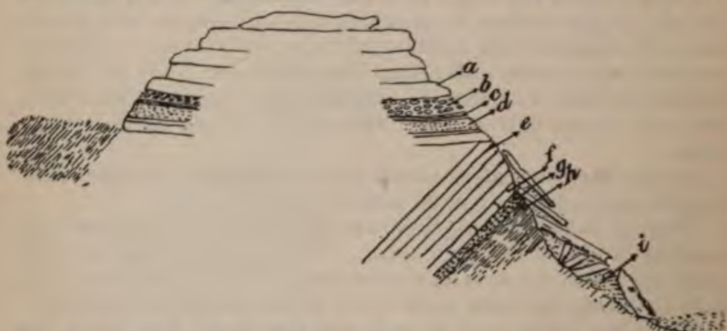


Fig. 63.—Contiguity of the older and younger formations.—*a*, Quartzite; *b*, conglomerate reef; *c*, slate; *d*, clay; *e*, quartzitic sandsone; *f*, quartzite; *g*, conglomerate reef; *h*, schists; *i*, alluvial.

appearance, so that they yield a fine powder when rubbed between the fingers. When deeply buried beneath the younger beds the conglomerate is very hard, and the pebbles are red and white, dull looking, less defined, and farther apart. The whole appears more like an igneous rock with much iron pyrites, but the yield of gold is satisfactory. The regular formation runs from north to south, and dips at an angle of 60° to the east under the above-described younger beds (Fig. 63, *e*, *f*, *g*, *h*). One reef is exposed having a width of from 4 to 12 inches and very rich in gold.

The conglomerate contains small pebbles, very compact and *firmly cemented,* with reddish matrix. Often it is found much *honeycombed,* and contains iron pyrites with visible gold. The

hanging- and foot-walls are well defined; talc schists and blue slate (with gold) accompany the former, and quartzite the latter.

There are small gold-bearing quartz and conglomerate veins occurring westwards in slate, but owing to the numerous faults their working has not been successful. For about 3000 feet east from the reef outcrops the area is covered by the nearly flat-lying younger beds, which thin out to a feather edge, beyond which is a thick conglomerate bed, 6 to 15 feet wide, dipping east (Plate VI.).

This conglomerate consists of large oval pebbles, but is poor in gold. The reef can be traced for a good distance to the north, where it makes a bend to the east, and southwards it continues interruptedly. The outcrops are frequently seen, especially in ravines and in the beds of streams.

The formation containing the Du Prees Reef series sometimes consists of two parallel slate belts, well stratified and separated by a wide belt of quartzite about 500 feet to 2000 feet in width; sometimes of thinner bedded slates with thin seams of quartzite. Little is known about these beds, except that they are much faulted by dykes of diorite or greenstone.

2. The Main Reef Series.—No other series on the Witwatersrand Goldfield has been more closely studied, or more fully developed than this one. Most of the gold produced in the Transvaal is derived from it. The outcrops for thirteen miles to the east and eighteen miles to the west of Johannesburg have been in many places most valuable, and have attracted the attention of a great many prospectors and investors. They form a continuous line of mines from east to west, with here and there faults which, in many cases, have shifted the strata a little to the south or north.

The accompanying sketch (Plate VII.) gives the fairly straight outcrop lines of the Main Reef series, with their varying angles of dips, and the farms where the principal mines are situated.

There are four separate reefs, which are called respectively—North Reef, Main Reef, Middle Reef, and South Reef.

The outcrops project well above the surface, but for short distances only. Their position is approximately fixed by careful attention to the succession of the associated strata, notwithstanding the great variation in the appearance of the reefs; in this respect they resemble the reef of the Du Prees series. The gold is more plentiful in some parts than in others, but long stretches are quite barren.

The *pebbles of* the Main Reef series consist mostly of white,

dull-looking quartz, and are of a round or flat oval shape, the size varying from that of a small grain to that of a hen's egg. The difference in the pebbles of the several reefs is hardly perceptible, but those of the Main Reef are the largest. Occasionally fine grains of gold are found in the fissures of broken or cracked pebbles, but most of the gold is obtained from the matrix in which they are embedded. The cement is similar to that seen in the conglomerates of the Du Prees series. The gold generally occurs as very small particles in pyrites.

The pebbles are smooth and soapy, and are so loosely enclosed in the cement that in breaking up the conglomerate they often fall cleanly out as from a shell. In most cases the largest pebbles are found on the foot-wall, and the smaller ones towards the hanging-wall of the reef (Fig. 64).

The gold is very unevenly distributed in the Main Reef series as a whole, so that were it not for the more valuable contents of the smaller reefs the average yield would not be sufficient to pay the working expenses. These smaller reefs or leaders often carry as many ounces of gold per ton of ore as the larger bodies yield pennyweights; but taking one with the other the result is a fairly payable average.

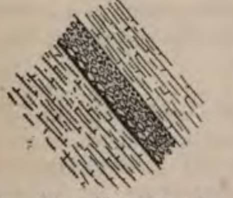
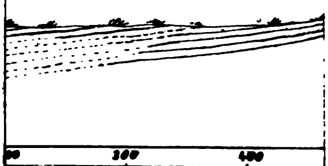


Fig. 64.—Showing the largest pebbles on the foot-wall of the reef.

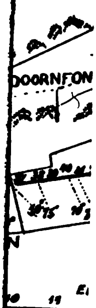
The gold contents vary from 1 grain to 10 ounces per ton (2000 lbs.) of ore. The sandstone associated with the conglomerate, especially those formed of coarse grained, carry gold in places. The quartz leaders frequently observed in the conglomerate bodies are often richer than the reef matter itself. In some parts much shale separates the sandstone, and occasionally the reef rests immediately upon it, forming the foot-wall; or it takes the place of sandstone between two veins traversed by many quartz strings. Igneous rock also often accompanies the conglomerate reefs, and sometimes intrudes between them. In the area of the Main Reef series, bands of quartzite frequently occur, and the sandstone near such bands is then darker in colour. When the conglomerate is found as a very large body the central portion is usually sandstone or shale, and where it thins out clear divisions of smooth walls are perceptible. Sometimes the conglomerate rests directly on sandstone, or it has a *well-defined*, hard, thin, slate-like crust as foot-wall.

All the reefs or leaders comprising the Main Reef series, as



WATERVAL FARM.

ler beds. *c*, Limestone.



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will be seen, are separated by bands of intervening sandstone, shale, or igneous rock; where these thin out the reefs combine to form large bodies; and where they thicken the reefs are resolved into numerous smaller ones. Hence it often happens that the reefs change so much in character that it is often a difficult matter to distinguish each particular reef from the others.

The Main Reef itself is usually a large body from 3 feet to 15 feet in width; but so far as explored it has been found to be poor in gold, averaging only from 3 to 5 dwts. of gold per ton; hence it has been but little mined. It is only exceptionally that it has been found to be worth working.

The most payable and best-developed reefs are the Main Reef leader and the South Reef, both varying from 1 inch to 4 feet in thickness and lying to the south of the above. In some places the Main Reef leader rests directly upon the Main Reef, in which case the adjoining part of the Main Reef must in many instances be mined with it. In other instances they run parallel with each other, and are separated by a narrow sandstone parting or by a thin clay vein.

The Middle Reef is from 2 to 6 feet wide, but is rarely worth working. It is situated between the Main Reef leader and the South Reef: hence the name. On the Roodepoort, Vogelstruisfontein and Paardekraal farms, the Main Reef leader and Main Reef are extremely irregular in mineral wealth.

The more important South Reef (which is from 100 to 200 feet distant from the Main Reef) carries the richest gold on its foot-wall, and is the best-paying body throughout the Witwatersrand. When divided into two or three veins by sandstone partitions, the lowest vein has the most gold.

On the Langlaagte, Klipriversberg, and a portion of Doornfontein farms, the two valuable gold producers—viz., the Main Reef leader and South Reef—closely approximate to the Main Reef, in which case the latter is only partly mined.

On Elandsfontein, and a portion of Doornfontein farms farther east, the North Reef and Main Reef leader keep close together; but there the Main Reef and South Reef are only sometimes valuable. In some instances, the Main Reef, Main Reef leader, and North Reef yield equal quantities of gold; in such case the sandstone parting is narrow, and the reefs are of medium size.

In some places a payable conglomerate intervenes between the Main Reef and North Reef, and the associated Main Reef is usually low graded. The North Reef and this new Middle Reef may sometimes have a wide shale parting, or the latter may have shale bands on its foot-wall, or the shale may appear

near the Main Reef, and be associated with the South Reef carrying little gold, or no gold at all.

Near Boksburg the North Reef bears the gold, and rests directly on, or is in parts embedded in, the shale. The South Reef gradually diverges from the North Reef to the extent of 600 feet or more, when it again becomes a payable body.

The distance between the various reefs varies considerably. The instances given below are some results of the author's measurements on the strike of the Main Reef series in the area between the Roodepoort and Elandsfontein farms. Main Reef —width, 3 feet, 3½ feet, 4 feet, 6 feet, 12 feet. Sandstone parting between the Main Reef and Main Reef leader—1 inch, 2 feet 5 inches, 1 foot, 3 feet 6 inches, 3 feet 11 inches. Main Reef leader—1 inch, 2 inches, 1 foot, 1 foot 2 inches, 6 inches, 3 feet, 2 feet 9 inches. Sandstone parting between the Main Reef leader and South Reef—100 feet, 150 feet, 40 feet, 70 feet, 20 feet, 54 feet, 400 feet, 600 feet. South Reef—2 inches, 8 inches, 5 inches, 3 feet, 4 feet 10 inches, 7 feet.

The following section will enable the reader to form a clear idea of this variation, the position of the payable ore, and the direction of the Main Reef series.

The distance between the outcrops the author has measured approximately, where obtainable, in sections, and connected them with the line of their course. (See Plate VIII.)

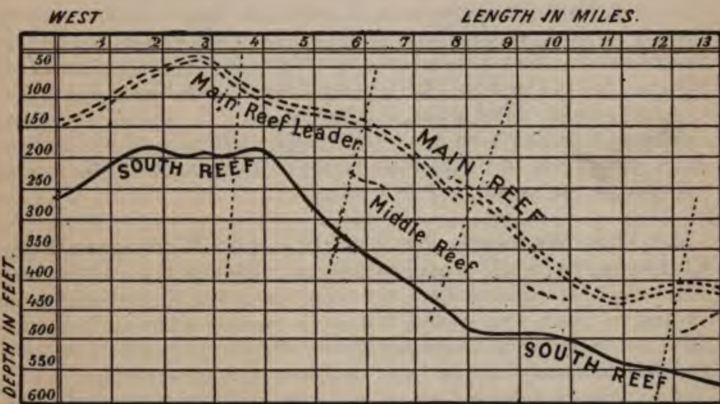
3. Eastern Portion of the Witwatersrand and Heidelberg Districts.—From the Driefontein farm the series has a south-eastern strike to the Vogelfontein farm, after which the entire formation seems to disappear under the Karroo beds.

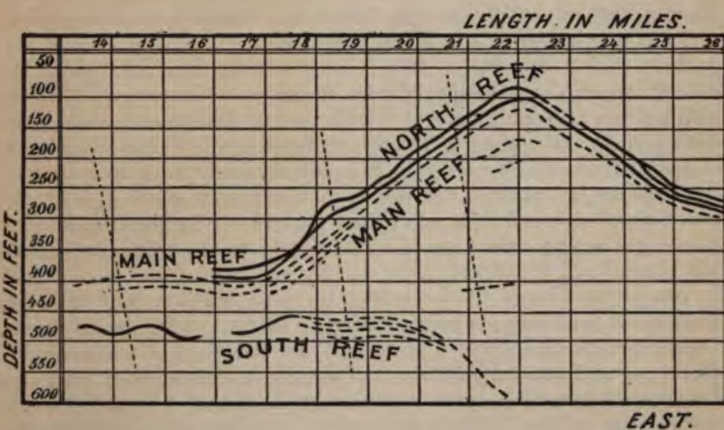
On the Bononi and Kleinfontein farms farther north, reefs are exposed again, and several profitable mines have been already established. The reefs have a southerly and northerly direction.

In Vlakfontein and Modderfontein farms, they take an easterly and westerly course, and may be traced as far as Klipfontein farm.

The overlying surface soil or younger beds, which carry coal seams, make the tracing of reefs in the neighbourhood uncertain. They are again discernible 14 miles south, on the Vlakfontein farm, where the conglomerate reefs take first a north and south strike and west dip, then an east and west direction and a north dip; and are afterwards prolonged to, and past, Heidelburg township, usually with a west dip. Again, south-east of this town, for over 20 miles on both sides of the Johannesburg-

SKETCH DIAGRAM OF THE WITWATERSRAND MAIN REEF.





Gold in payable bodies, ————————

Reef known to be poor, - - - - - - - - - - -

Farm Boundaries, ...

PLATE VIII

Natal railway line, conspicuous conglomerate outcrops are to be found, some of them dipping south, and others north.

The outcrops in this district cannot be continuously followed, owing to the numerous faults.

At the Varkenfontein farm, a quartzite and shale formation, similar to that at the Witwatersrand, is well exposed, dipping about 30° N. Some conglomerate reefs form outcrops, and one of these, called the Nigel Reef, is considered to be highly valuable, and has yielded much gold.

The gold finds which have been reported from time to time on several reefs indicate that many of them will develop into gold-producing mines.

4. The Western Portion of the Witwatersrand, Klerksdorp, and Potchefstroom District.—About 17 miles west of Johannesburg the whole series is disturbed by an extensive fault, called the Witportje fault. This fault passes from the Welgespruit farm on the north-west through Witportje and Rietfontein farms on the south-west [? south-east].

The beds on the western side of this fault are shifted about 4 miles towards the north, and at this distance from the regular Main Reef series on the eastern there occurs a series of reefs, locally named the Bothas series, although there is no doubt they are a continuation of the Main Reef.

This series runs in an easterly and westerly direction through the Witportje and Luipaardsvlei farms, and consists of a well-defined massive conglomerate (with large pebbles) and numerous small reefs, all running almost parallel with each other and dipping about 30° S. It closely resembles the Main Reef series as regards its nature, the mode of occurrence of the gold, the continuous succession of active mines, and in the shifting of the most productive sites from the main body to the smaller reefs in the south, and *vice versâ*.

About 5000 feet to the south there is another well-defined auriferous reef-body, locally called the Battery Reef, which runs parallel with the above-mentioned one through Luipaardsvlei farm. The foot-wall of this reef carries the most gold, and its bipartition into two reefs is manifest in places. It has several flourishing mines. There are other conglomerate outcrops in this neighbourhood, which, as they may represent other series, are further alluded to under the heading "Other Series South of Main Reef Series."

On the western portion of Luipaardsvlei, and on Waterval farm west of Krugersdorp, this formation, with its many con-

glomerate beds, makes a sharp turn to the south, and the outcrops are rapidly and successfully covered by younger deposits. About 1 mile further south two series of outcrops occur, running parallel in a northerly and southerly direction and dipping easterly. One of these is situated on Witvalfontein farm, and has already been much explored, and the reefs, which also combine and divide, are profitably worked.

A number of active mines have been established, and a township has been laid out, called Randfontein. The second series is situated about 6000 feet west of the first on the Randfontein farm, and crops out on the surface owing to the absence of the younger beds. The large and small bodies of conglomerates exposed here are generally of a low grade nature on the surface, but the author found one, a thin outcropping leader, which gave, in some places, excellent results. Very little work has been carried out on this series.

Although the Bothas and Battery Reef series do not connect with the Randfontein and Uitvalfontein groups, the probability is that they are a disconnected portion of the same system of lodes, although the whole western portion of the Witwatersrand formation, west of the Witportje fault, has the form of a half-circle, in which the reefs show a considerable development in their number and size, and from the disturbed state of the ground it is difficult to establish the connection suggested.

The outer portion of the curved band, which is formed of alternate layers of shale and quartzite (Du Prees series), turns at the western portion of the Waterval farm, and can be followed through the Elandsvlei farm southwards, where traces of the Hospital Hill shale are distinctly visible about 5000 yards west of Uitvalfontein. South of Randfontein the reefs take a slight turn to the west, and, owing to disturbances, overlying beds, and soil deposits, the continuation to the adjoining Middelvlei farm cannot be actually traced. The slate formation outcrops again in the township of Kocksoard, near Middelvlei.

Some miles to the west, on Hartebeestfontein and Witfontein farms, there are numerous reefs of conglomerate beds with large and small pebbles; some of the reefs are sufficiently gold-bearing for profitable working. West of these farms a shale formation is seen resting on granite, which can be traced interruptedly in a south-westerly direction towards Potchefstroom and Klerksdorp.

Within about 20 miles west of Potchefstroom, two broad and well-defined bands of shale crop out on Luifontein farm and dip 20° S.E. They are separated by a sandstone belt about 3 miles

wide. Very few gold-bearing outcrops are visible, except towards Klerksdorp, where several have been discovered. A gold-bearing reef belonging to the younger beds (Black Reef series) is traceable for a considerable distance in a north-easterly and south-westerly strike, probably overlying other valuable series. A number of other reefs can be traced here and there in outcropping masses with various strikes and dips, but the disturbances have made mining progress somewhat difficult, but much prospecting and mining have been done along a quartzite which is associated with a thin vein of a pyritic blackish matter having a payable yield of gold; this vein frequently shifts its position from the hanging- to the foot-wall. The conglomerate, which is sometimes seen next to the quartzite, is of no importance.

About 10 miles west of Klerksdorp several reefs crop out at Rietkuil, Elandslaagte, and Welverand farms, and form a curve having a chord of about 7 miles, the beds of which dip towards the middle.

The reefs mentioned in the foregoing chapters have already produced many million ounces of gold, and, according to experts, the amount of wealth in sight is far greater than the produce of the past.

5. Other Series South of the Main Reef Series.—On the whole, the Witwatersrand fields have been the most uniform in their yield, and therefore the knowledge acquired in these forms a useful guide for prospectors in districts where the formations are to a certain extent similar.

The series which lie above the Main Reef series, but which have not yet been described, are also of great value for judging or locating the different ones elsewhere. It is not impossible that this series, known to be rather poor in gold, may carry more gold elsewhere, or it may be (as in the main belt) that a series cropping out in one farm does not do so in another. It is especially difficult to identify a series when only a few exposures are to be seen in a vast expanse of surface beds with a low dip.

The experience on the Main Reef series is that the profitable working of properties depends on special search being made for the richer reefs and small leaders; and in the more economical working of the low-grade ores. In some of the mines at Witwatersrand the profit is obtained by selecting the rich ore and rejecting the poor. The following is a summary in ascending order of the reefs occurring in the Witwatersrand belt, south of the Main Reef series and parallel with it:—

Most of the pebbles consist of white quartzite and quartz, but some are of a slaty nature. They are larger than those in the Main Reef series. The dip lessens as we advance south, and the gold contents of the reef vary.

Within a distance of about 3000 to 4000 feet south of the Main Reef series there occur the "Livingstone Reef series," with from two to six outcropping conglomerate reefs, and the "Bird Reef series," with three or four, the reefs being separated by sandstone. About 5000 feet further south there is the "Kimberley series" (with about seven reefs), formed of sandstone and shales.

About 10,000 feet still farther south is the "Elsberg series," with about thirty reefs interbedded with sandstone, traversed by dykes and in places by the igneous rock, which again is overlain by the horizontal beds of the "Black Reef series," which has several conglomerates.

6. The Black Reef Series.—The outcrops of this irregular series take a broken easterly and westerly direction, near the "Klip river," about 7 miles south of the Main Reef series at Johannesburg.

The reef is profitably worked on the Roodekop farm on the east, and in the west on Middelvlei farm, west of Krugersdorp. The deposits of Waterval farm, already noticed, are similar, which suggests the inference that the older beds of the Witwatersrand were once covered by younger beds, outlying patches of which are still to be found in all parts of the country, occupying protecting hollows in the older beds, or preserved from denudation owing to fissures having been filled with dykes of igneous rock. In some of these outliers, especially when the strike of the beds changes abruptly, valuable chutes have been discovered which enhance the importance of the reef locally. These occur in the most out of the way places at great distances apart. The gold contained in these chutes varies from 1 dwt. to 4 ozs. per ton of 2000 lbs. weight. In the Heidelberg and Klerksdorp district these beds have the same features.

The Black Reef series consists of quartzitic sandstone, quartzite, and, occasionally, shale; this embraces several reefs, of which the largest known body is named the "Black Reef." The beds dip from [illegible] 14°.

The w[illegible]series takes its name from the black appearance of this reef [illegible]rop, originating from the oxidisation of the contained iron pyrites.

The conglomerate is much decomposed, so that the mining

and milling of the ore is easy. It consists of round white quartz pebbles of medium size; red or blue chert pebbles are found amongst them in the parts containing most gold.

The reef averages from 1 to 3 feet in width; but it is sometimes as much as 12 feet thick.

In some localities there appear to be two bodies separated by a narrow but distinct partition. The gold is then found sometimes in the upper and sometimes in the lower body. When the lower reef is replaced by a seam the gold is distributed throughout this seam (Fig. 65).

On its foot-wall it carries a very pyritical, thin seam of shale, containing much gold; or a soft clay seam takes the place of this. In some parts the seam is absent, and the reef then lies immediately on the diabase rock, which, as before referred to,

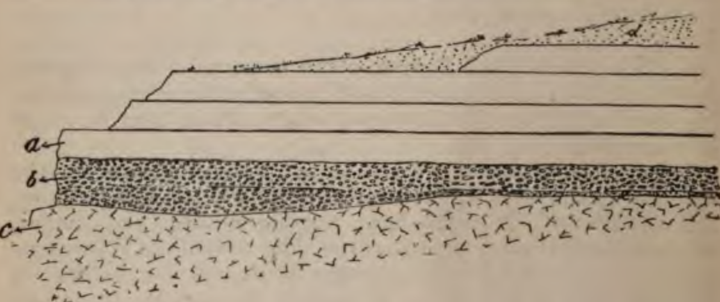


Fig. 65.—Black Reef.—*a*, Quartzite layer; *b*, reef with partition; *c*, diabase; *d*, shale or clay seam.

separates the older series (Main Reef series) from the Black Reef series. The surface of the igneous rock is uneven, and hence the foot-wall undulates somewhat. The gold is chiefly found on the underlie portion of the reef, and very rarely near the hanging-wall.

The hanging-wall or roof consists of a well-defined layer of quartzite from 1 to 2½ feet thick. In some localities the quartzite layer is absent, and is replaced by a shale. The roof-wall quartzite layer is generally found to be more closely connected with the reef than with the overlying formation (quartzitic sandstone), therefore both must be mined; so that it is necessary to sort the rich rock from the barren stone. In doing this *constant panning* is necessary in order to determine where the *most gold occurs.* The author has often noticed the clay and

shale to be extremely rich in gold, and that this very thin portion is worth much more than all the rest of the reef. A good deal of the gold is shaken out during transport, so that precautions should be taken to diminish this loss by sweeping the floor of the works, studying economy in mining, working on a small scale, and exercising due care.

In places there are smaller reefs or stringers embedded in quartzite and interveined by a softer sandstone, which belong to a series younger than the Black Reef. Some are quartz reefs. Little attention has been given to them, but they are supposed to be of no value.

7. Disturbed State of the Reefs.—In taking a general view of the difficulties attending prospecting and mining, great importance must be assigned to the thorough study of the faults

Fig. 66.—Fault.—*a*, Displaced conglomerate reef; *b*, fracture.

and dykes met with in these goldfields. These are mainly attributable to the intrusion of the granite and the consequent faulting met with in almost every mine. (The term "fault" means a rent in the strata accompanied by a displacement.) Such fractures may leave a space which has afterwards been filled with clay or small pieces of rock (Fig. 66).

A careful study of the faults will generally remove any difficulty there may be in determining the original position and connection of the strata.

Dykes traverse the beds in all parts of the Witwatersrand,

and look like a reddish slaty-like rock, which may be 100 yards wide and which is apt to be mistaken for a shale. (The term "dyke" means a mass of igneous rock which has pushed its way through the fissures of the formations.) Some dykes cut out the reefs, while others have no appreciable effect, but appear as red clayey matter (Fig. 67). The large Witportje fault referred to on p. 96 is very conspicuous in places; it seems to displace the whole western portion of the Witwatersrand to a distance of many miles.

At the East Rand there is a large mass of igneous rock, but no trace of the Main Reef series itself is to be seen.

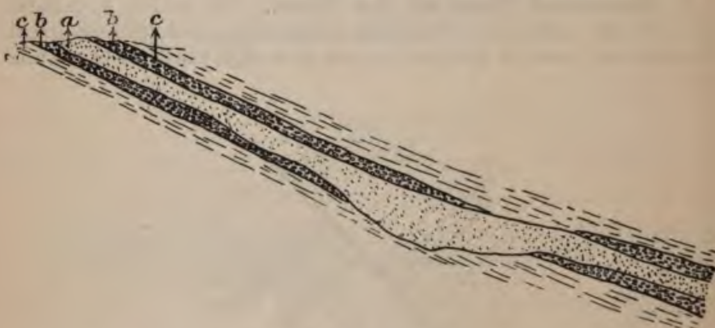


Fig. 67.—Dyke.—*a*, Ign ous rock accompanying the reef; *b*, pinching out and re-appearance of the reef lower down; *c*, quartzite.

In other places along the Witwatersrand line the formation has been shifted for a short distance only, sometimes to the south and at other times to the north. This causes the unusual dips and strikes or overlappings of the reefs. Difficulties are met with during mining operations due to other causes, but these are easily overcome after a little practical experience.

Witwatersrand Gold Yield.—The monthly lists of gold outputs at the Witwatersrand are published by the Chamber of Mines at Johannesburg, and details are specified in the *African Review* in the first month of every year. The following returns are taken from that journal:—

MONTHLY OUTPUTS OF THE WITWATERSRAND GOLDFIELD.

In the Year	1887.	1888.	1889.	1890.	1891.	1892.
	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
January, . .	...	7,328	25,506	35,007	53,205	84,560
February, . .	...	12,180	22,457	36,887	50,079	86,649
March, . .	...	11,976	27,919	37,780	52,949	93,245
April, . .	...	14,146	27,029	38,697	56,372	95,562
May, . . .	887	13,397	35,028	38,836	54,673	99,436
June, . . .	734	12,773	30,878	37,419	55,863	103,252
July, . . .	240	16,687	31,091	39,457	54,924	101,279
August, . .	1,409	18,616	30,520	42,864	59,070	102,322
September, .	1,936	20,242	34,143	45,486	65,602	107,852
October, . .	4,029	27,165	32,214	45,249	72,793	112,167
November, . .	5,463	26,827	33,722	46,783	73,394	106,795
December, . .	8,457	26,784	39,050	50,352	80,323	117,748
Total, . .	23,155	208,121	369,557	494,817	729,247	1,210,867

In the Year	1893.	1894.	1895.	1896.	1897.	1898.
	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.
January, . .	108,374	149,814	177,463	148,178	209,832	336,557
February, . .	93,252	151,870	169,295	167,018	211,000	321,238
March, . .	111,476	165,372	184,945	173,952	232,067	347,643
April, . .	112,053	168,745	186,323	176,706	235,698	353,243
May, . . .	116,911	169,773	194,580	195,007	248,305	365,016
June, . . .	122,907	168,162	200,941	193,640	251,529	365,091
July, . . .	126,169	167,953	199,453	203,873	242,479	382,006
August, . .	136,069	174,977	203,573	212,429	259,603	398,285
September, .	129,585	176,707	194,764	202,561	262,150	408,502
October, . .	136,682	173,378	192,652	199,889	274,175	423,217
November, . .	138,640	175,304	195,218	201,113	297,124	413,517
December, . .	146,357	182,104	178,428	206,517	310,712	440,674
Total, . .	1,478,475	2,024,159	2,277,635	2,280,893	3,034,674	4,554,989

The gradual increase of outputs shows the importance and value of this goldfield.

CHAPTER XII.

GOLD DISCOVERY IN THE NEIGHBOURHOOD OF THE WITWATERSRAND.

BLAUWBANK GOLDFIELD.

NORTH of the Witwatersrand Goldfield the country slopes gently northwards, and is traversed by numerous water-furrows, streams, and rivers, which frequently expose auriferous reefs. Alluvial deposits are often met with, and gold nuggets of substantial size have been found in yellow clayey gravel or black soil-wash; whereas, on the higher ranges of the Rand, the alluvial gold occurs in white quartz leaders. It was by following such traces that the Witwatersrand Goldfields were discovered.

On one side of the upheaved granite, the Witwatersrand beds dip south, and on the opposite side, the Cape Formation (similar to the Black Reef series) dips north.

The Karroo Formation overlies this in various parts. In the west of Krugersdorp a large belt of metamorphic limestone or dolomite, 2 to 5 miles wide, extends towards Marico and Pretoria districts, in which argentiferous (silver-bearing) galena, copper, bismuth, iron, magnesia, and gold are known to exist. It may be mentioned that the dolomite occurs in many other localities. On the Blauwbank farm, about 17 miles west of Krugersdorp, a gold-bearing formation is associated with the dolomite. It consists of schists and soft, nearly flat-bedded, quartzitic sandstone, dipping in all directions. Many diorite dykes traverse the country.

On the north of this farm a well-defined range of hills stretch from east to west, called the "Witwatersberg." The upper part of these mountains is formed of quartzite beds, which sometimes incline to the north and sometimes to the south, with igneous rock and, in parts, the primary formation beneath them. The wide northern valley chiefly exhibits granite and large diorite dykes. The Witwatersberg can be well followed in its

course past the Witwatersrand on the north, towards Pretoria, accompanied by the auriferous belt; and beyond it the bold outline of the Magaliesberg, formed mainly of quartzite and shale, is visible in the distance.

There are many valuable minerals, such as ores of copper, silver, &c. The auriferous belt is well displayed on the Blauwbank farm.

The chance discoveries of rich finds in former times on this farm caused much excitement and led to many failures, which soon compelled a more careful study, but further discoveries of alluvial deposits and reefs may yet be made on this farm and on the extension of the same beds beyond its limits. The Vogelstruisfontein farm, situated further west, has also become of importance, owing to the rich gold-bearing alluvial deposits found on it. A gravel, several feet thick, resting upon shale beds and formed of small and large pieces of white glassy quartz has yielded much nugget gold. The surface of the country consists mainly of table-like hills formed of horizontal quartzite and shale, resting upon an inclined shale and quartzitic sandstone formation. Between these hills the valleys are composed of alluvium, sloping gradually to the river banks.

In one of these, called the "Golden Valley," situated on Blauwbank, and running from a high point on the south-east to a branch of the Crocodile river on the north-west, most of the principal alluvial diggings are to be found. In the centre of this valley, where it takes a turn around a hill or kopje, there is a large deposit of alluvium, which, although low in grade, is uniform in its yield of gold. Also on the top, and on slopes about 50 feet higher, coarse gold can be found tilted in the joints of the strata, where many trenches made by the gold-seekers are still to be seen. At the lower end of the valley, where a little stream drops steeply down a rocky kloof to the river, the alluvial is washed away, and a tilted shale formation is exposed. In this a narrow, nearly vertical quartz reef has been opened, carrying good gold, where probably the alluvial settlement has improved its value. On the river below the valley large nuggets of gold were washed out of the deposits between the big boulders of diorite by the earlier diggers. The overlying beds, which are conspicuous in all the small hills, carry numerous small quartz veins, some containing gold, which is chiefly found in the decomposed parts between quartz. The value in a great many of these quartz veins may be due to the settlement of fine gold brought by floods from other sources. Opposite the Golden Valley, and on the other side of the river,

a more massive horizontal reef is exposed, and has been much worked; but apparently there is no continuance of it. The quartz is of a white colour, and bears a yellow or reddish-clay sediment between the crystals, or is much honeycombed, and contains rich gold. It crops out on a hill on the banks of the river, and is embedded in a thick layer of quartzitic sandstone (Fig. 68).

Similar flat reefs are laid bare in other places, but they are very low graded. A short distance north of this formation a very large diorite dyke, in places nearly 1000 yards wide, intrudes from south-east to north-west, and the Witwatersberg range extends beyond it. North-east of this a conglomerate is met with, but it contains no gold in the outcrops.

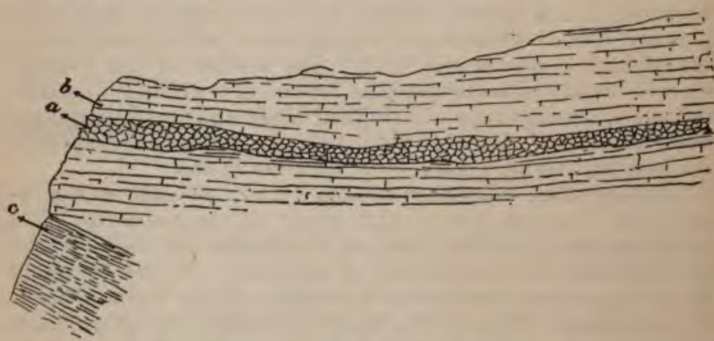


Fig. 68.—Quartz reef on Blauwbank farm.—*a*, Reef; *b*, quartzitic sandstone; *c*, underlying shale.

LIMESTONE BELT.

The limestone belt has many interesting features. The sources of the head tributaries of the Crocodile river rise on the high, flat, limestone belt, which runs south of the Blauwbank gold-bearing formation, in large block-like layers. These limestone layers alternate with thin blue quartzite beds; the water trickles from the edges of the alternate beds where they appear on the slopes, and runs downwards in little streams (Fig. 69).

Underground rivers are common in this formation. On the Sterkfontein and Waterval farms, near Krugersdorp, a good-sized river can be followed for some distance, when it disappears

under the limestone, and, miles further on, it again comes to the surface. Such underground rivers often form large subterranean lakes.

The well-known stalactite caves of Sterkfontein give evidence of the wonderful action of water under the surface. These caves comprise a large chamber from which narrow passages lead into many smaller chambers; these ramifications extend to an unknown distance. The walls, floors, and roofs of the archways and dome-like chambers are decorated with wonderful shapes of white, glittering, icicle-like stalactites.

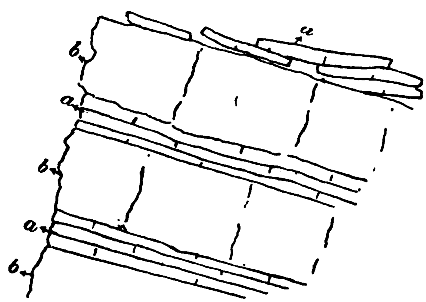


Fig. 69.—Limestone formation.—*a*, Quartzite; *b*, limestone.

These interesting and crystal-like growths are formed in a curious manner, principally by the slow dropping and gradual evaporation of water after it has become charged, first with carbonic acid, and then with carbonate of lime, during its slow filtration through the limestone rock. These stalactitic hollows and caves abound in this belt. There are many limeworks between Pretoria and Marico where this limestone is treated.

CHAPTER XIII.

THE MALMANI AND VRYHEID GOLDFIELDS.

Malmani Goldfield.—About 4 miles from the Bechuanaland border gold-bearing quartz reefs occur in the same limestone formation; this auriferous area is known as the Malmani goldfields, of which "Ottos-Hope" is the central mining camp (Plate IX.).

The reefs strike north-north-east to south-south-west, and their outcrops are seen in several places. They are difficult to trace, as the bands of dolomite blocks are very similar in the different reefs. It is called by the Boers "Olifant Klip," because the oxidised crust resembles the skin of an elephant.

Several reefs have been discovered on both sides of the Malmani river. A few of them carry gold well in places, and the testing results have kept the field constantly under notice. The principal lines of reefs are called the Crystal Reef, the Pioneer Reef, and the Mitchell Reef.

Where the quartzite forms the casing the outcrops are massive, and the reefs are then lost sight of for a great distance.

When followed downwards the quartzite sometimes disappears, and the quartz combines with the dolomite in the form of white leaders, frequently thinning to nothing; or, a thin clay seam passes around the obstruction to where the reef is again struck.

The richest gold is found in chutes of white quartz, and is associated with carbonate of copper, which gives the whole reef a greenish tint. Visible gold is frequently met with. On the Wolvekopje farm, at its extreme north-north-west side, a number of small and large reefs are met with, running close to, and parallel with, each other; they crop out where the quartzite breaks through the dolomite. Others, again, are of alluvial nature; they dip down in the same vertical manner as the others; but the reef now consists of quartz and dolomite crystals of all shapes, forming here and there reef-like bodies, very marshy, sandy, and light, containing copper pyrites, and, occasionally, crystallised gold-grains.

The space between the reef and dolomite is filled with black, light soil; here, also, much coarse gold is obtained (Fig. 70).

Although the outcrops are sometimes large, the majority are

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small. The whole, however, could be treated in the same way as alluvial deposits are. The gold it contains could no doubt be profitably extracted by carrying out the economical suggestions before recommended—viz., by working small concessions.

On the south of the dolomite belt, quartzitic sandstone, with a wide conglomerate outcrop, can be followed for a long distance, but gold is absent. About a few hundred yards further south the granite spreads over a large extent of country. In the north the limestone disappears as the mountainous country is approached, which consists of shale and sandstone, and where also the quartzite formation occupies a great space. Copper ore, associated with gold, can at times be noticed. The author, when passing through these mountain ranges, has seen many old workings extending for a considerable distance below the surface, giving evidence that large works of a profitable industry had formerly been in operation; for, after passing through narrow passages, the explorer is astonished at the great gaps and hollows which have evidently been the receptacles for the washed surface soil. Most probably these old excavations were made by the natives in order to obtain the metals (copper, silver, and iron, which are known to exist in these ranges) used by them in making their jewellery, ornaments, and weapons; the old melting pots are still to be found in the vicinity of the workings.

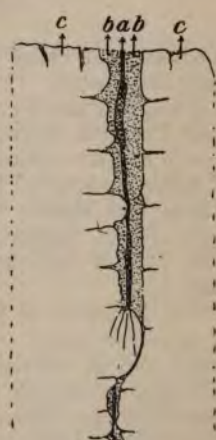

Fig. 70. — Auriferous reef in limestone.—*a*. Quartz reef; *b*, black soil; *c*, limestone.

A Gabbro formation lies beyond the mountain ranges mentioned above.

Vryheid Goldfield.—This goldfield is situated on the border of Zululand and Transvaal, and extends into both these countries. Near the Umvolosi river, conglomerate reefs have been discovered, and, according to reports, these are similar to those in the Witwatersrand, and contain an average value of 15 dwts. of gold per ton of rock.

Abundant quartz reefs can also be traced for several miles. The yield of gold has been small and prospecting has been somewhat neglected, so that there is another great opening here for the explorer in the future. The author has no personal knowledge of this field.

CHAPTER XIV.

OTHER MINERALS.

Besides gold, other valuable but less interesting minerals have been discovered.

Diamonds are found in the banks and beds of the Vaal river, near Pretoria, in the Waterberg district and North Transvaal, and in the Klerksdorp district.

Silver is found in the Pretoria district near the Magaliesberg Range and Marico district, principally associated with ores of copper, lead, antimony, and iron. Near Pretoria, reefs from 3 to 11 feet in width have been opened up (Transvaal Silver mine).

Tin is found in Swaziland in alluvial deposits on granite. A large concession has been secured on which it is worked, and many tons of this metal have been extracted.

Copper occurs in the lower part of the Murchison Range, Zoutpansberg, Marico and Magaliesberg Range. It is associated with silver in the Pretoria district (Albert's Silver mine).

Antimony occurs along with gold ore in the main belt of the De Kaap Goldfield and in the Murchison Range; also as deposits near Steynsdorp and Zoutpansberg.

Iron abounds in the northern districts; the natives have made much use of it in the construction of assegais and other weapons.

Cinnabar occurs in Zoutpansberg in the eastern De Kaap and Marico district as small scattered veins in but few places.

Sulphur occurs in the Marico and Waterberg district.

Lead.—Large and small pockets of galena are scattered in the limestone and quartzite formation in the Marico district. It often contains silver.

Coal.—This useful and necessary mineral is found in thick and thin seams interbedded between white sandstone layers, and is to be found in most parts of the high country (Tableland*). (See p. 6.)

* *W. H. Penning, On the High-level Coalfield of S.A.*, 1884.

Salt occurs between Blauwberg and Zoutspansberg Mountain.

Plumbago is found in the Marico district.

Saltpetre occurs in the Marico district.

Mica is met with in the Carolina and Zoutpansberg district.

Asbestos occurs in the Carolina district, De Kaap and Magaliesberg Range.

Many other useful minerals have been reported, but, owing to the eager search for gold, very little notice has been taken of them.

General Remarks on the Goldfields.—The careful observer must undoubtedly acknowledge that everything points towards the existence of great mineral richness, a still greater wealth to be discovered, and opportunities for lucky discoverers.

It has been the desire of the author to touch merely upon the principal points in prospecting for gold in the foregoing chapters, in the hope that the information may be useful to an explorer. Few references, therefore, are made to individual concerns already established and continually reported upon, but the general characteristics of occurrences in nature are alone kept in view.

In summing up the facts one will come to the conclusion that the wealth already discovered is small as compared with what will be obtained. In the first place, thorough study and research have been mainly confined to the most profitable mines, and very small portions of the various reefs have been efficiently prospected. Thus the Du Prees series (1) has only been explored at and near the richer outcrops, and the main reasons why no other mine in this series than the Rietfontein is paying are insufficient prospecting and want of knowledge. It is in consequence of this lack of knowledge that no decision can be come to as to the position of the Kleinfontein group of mines or of the shale formation on the Nigel property in the Heidelberg district. These, and other instances, will suffice to show what a great scope there is for future development.

(2) The various other series lying south of the Main Reef series are of low grade. The long bands of conglomerate outcropping in Heidelberg, Venterskroom, Klerksdorp, and Potchefstroom districts, similar to those of the Witwatersrand, leave much to be desired as regards prospecting efforts.

(3) The alluvial gold and auriferous quartz reef formations noticed in this work give every promise of a prosperous future at some time or other.

(4) The undeveloped mineral resources are a sufficient inducement for efforts to be made to establish new industries.

Many of the Witwatersrand reefs have been hastily condemned because it was supposed that the gold was mainly near the surface, but the result of the sinkings to deeper levels is that, as a rule, the reefs are as rich below as they are above. Experts have estimated the value of the wealth in sight at a very high figure; but, in comparison with what the explorer may reveal, this is trifling.

It may safely be said that the natural resources of this marvellous land, where nature seems to have been boundless in her generosity, are practically inexhaustible. Imagination fails to picture the great future before it, but the practical man does not attempt to realise it; he places his confidence on the assurance that his reward will be ample if he persists and struggles through such difficulties as may arise.

CHAPTER XV.

CLIMATE—AGRICULTURE.

CLIMATE.

THE summer season, with its heavy rains and oppressive heat in the low-lying districts, is the unhealthy season; it comprises the months of November, December, January, February, March, and April.

Malaria is extremely severe in the swampy lower parts, where the damp or wet soil is without any drainage, especially during the first months of summer (November, December, and January) when the floods collect all undisturbed material of the dry season, on its way to the low country, in a half-rotten state.

The last month (April) is also severe, as the softened soil and swamps dry again to their usual state. These unhealthy parts are easily recognised by the thick fog over the low-lying lands, valleys, and river banks, resulting from the evaporation of the heated morass. The highest spots should always be selected for settling and camping purposes, as is done by the natives whose kraals are always found in a high position, where the air is fresher and more wholesome. Trees should always be planted in settled swampy localities, as they help to drain the soil and to render the district less unhealthy.

For instance, the De Kaap valley (2800 feet above sea level) was named the "death valley" in earlier days, on account of its high rate of mortality; whereas now, owing to the cultivation of the soil and the exercise of sanitary precautions, malaria fever has much decreased, so that any person leading a temperate life will find the climate agreeable. These remarks also apply to Pretoria, Lydenburg, Rustenburg, and Zeerust.

The northern country, sloping from the plateaus towards the sea, is sparsely inhabited and most unhealthy. For this reason it is necessary to be cautious in travelling. The country south and west of De Kaap Goldfield—Pilgrim's Rest, Lydenburg, Murchison Range, Klein Letaba, and the whole eastern portion of the Magato-berg Range—are included in it.

In the high country from 5000 up to a height of 6000 feet above sea level the heat in summer is occasionally great; but the cool breeze at night makes it pleasant. Owing to the natural drainage a dry air and soil prevails, adding greatly to the general healthiness. At the Witwatersrand watershed range much dust is a drawback to an otherwise healthy district. The winds in this high elevation are heavily laden with dust, and dreadful dust storms appear like dense clouds, causing much discomfort, owing to their lengthy duration, especially at Johannesburg, where the constant traffic intensifies the annoyance.

In many places on the high country, such as Ermelo, Carolina district, and on Devil's Kantoor, a sudden rising of mist is frequently experienced; indeed, the last-mentioned place is constantly hidden in the rainy season. Persons often go astray or run into danger owing to the frequent mists. The winter climate of the months of May, June, July, August, September, and October is perfectly bright and fresh, and is the best time of the year. The winter half of the year represents the dry season; but the heavy morning dews nourish the vegetation in the low country. Occasional showers of rain fall in the months of May and October, and the latter month is generally regarded as the best for planting. The burning of the long grass in the winter does much towards diminishing the prevalence of malaria in the summer. Night frosts are frequent on the plateaus.

AGRICULTURE.

The cultivation of the soil is generally admitted to be one of the most important factors in the development of a new country, leading to prosperity, steady improvement, and the general welfare of the community.

No doubt, too, it exercises a very wholesome influence in checking the rapid growth of all speculative systems with their exciting, enervating, and ruinous characteristics. This extensive young country, new almost to every one, offers possibilities for agricultural enterprise of an exceptional kind. Shrewd, practical, and energetic men might even find farming as profitable as goldmining; but free from the risks and disappointments peculiar to the latter.

The vicissitudes of fortune incidental to a new country render it very necessary that the new comer should be prepared to rough it at first, and ready to put his hand to anything and *everything; for* where agricultural pursuits are the staple

industry, no one need fear destitution, if capable and willing to work, and not too particular as to what that work is. It is men such as these that the new country wants. There is plenty of scope for any number of industrious men in this promising land. Tempting speculations and other ruinous undertakings often become fatal pitfalls to the unwary new arrival. If he happen to be one of those who is well provided with funds, he is often induced to depart from a wise and steady course, and lead a reckless life. It is, therefore, the author's intention to treat rather fully of the agricultural phases of the country, more especially those parts through which he has passed in the course of his travels.

For the sake of convenience and simplicity he has arranged the results of his observations and conclusions to suit the requirements of the two following classes, namely:—

1. Those who have insufficient capital, and are, therefore, compelled to seek an immediate return for their labour or outlay.

2. Those who have sufficient capital.

In the first case it is necessary to cultivate such products as will yield the quickest returns. Of these the following are the most important:—All kinds of grain food used for horses and cattle, and which can be ground into meal or flour. As nearly every sort of vegetable can be raised in this country, it is best to grow only those kinds most suitable for the nearest market, which, for preference, may be in the neighbourhood of large mines, or works where many persons are employed. They would require melons, water melons, grapes, tomatoes, potatoes, beans, peas, cabbages, turnips, lettuces, carrots, &c. As all these grow freely, they offer a certain source of income. The cultivation of tobacco, too, is not to be despised, as it thrives well here.

In the second case, of course, it is possible to organise everything on a more extensive scale, and to undertake operations of a much needed character, but from which no return can be expected for years, such as planting trees of all kinds.

The following is a list of the trees generally grown in the country:—

Aberia caffra or Kei apple, *Acacia dealbata* or silver wattle, *Acacia decurtens* or black wattle, *Hakea suaveolens* or Hakea, *Salix capensis* or Cape willow. These are useful for fencing or for protection, and for shelter against wind. The black wattle contains a large proportion of tannin.

Casuarina equisitifolia or beefwood, *Cupressus macrocarpa* or Monterey cypress, *Curtisia faginea* or assegai wood, Fabricia

lævigata or Australian myrtle, *Harpephyllum caffrum* or Cafer plum, *Laurus camphora* or camphor tree, *Populus fastigiata* or Lombardy poplar, *Quercus suber* or cork tree, *Tamarix orientalis* or tamarix, *Wellingtonia gigantea* or mammoth tree of California. These trees are recommended for plantations close to the homestead. *Quercus cerris* or oak, *Eucalyptus globulus* or blue gum, *Eucalyptus calophylla* or red gum, *Eucalyptus rostrata* or red gum, *Eucalyptus cornuta* or Yate, *Eucalyptus longifolia* or woolly butt, *Eucalyptus marginata* or Yarrah, *Eucalyptus resinifera* or Kino eucalyptus, *Eucalyptus obliqua* or stringy bark, *Eucalyptus robusta*, *Pinus canariensis* or Canary pine, *Pinus insignis* or pine, *Pinus pinaster* or cluster pine, *Pinus pinea* or stone pine, *Pinus rigida* or pitch pine. These are useful for timber in the mines and building, and for firewood. Yellow wood (native land, Cape Colony) is a very straight wood; stink wood (native land, Natal) is much used for waggons and furniture; sneezewood (native land, Natal) is free from insects; assegai wood (native land, Natal) is used for waggon wheels.

The fruits most cultivated in warm climates are peaches, apricots, quinces, bananas, pineapples, custard apples, mangoes, guavas, loquats, papaws, oranges, lemons, citrons, figs, olives, pomegranates, and granadillas.

The fruit trees adapted for the colder climate (high country) are plums, pears, walnuts, mulberries, and apples.

The sugar cane, cotton, tea, coffee, and rice are also useful plants that may be cultivated.

It is necessary for the settler who has chosen this form of enterprise to seriously consider the following questions :—

1. How is land for agricultural purposes to be acquired? The land owned by syndicates and companies is chiefly held by them for sale, lease, or rental, from a speculative point of view, from whom the newcomer has more opportunity in getting what he wants than by dealing with the farmers or agriculturists already settled upon the land and who know the value of it.

Large tracts of land are reserved for grazing purposes. Of course, it would be obtainable in many cases when vacancies occur by bankruptcy or death. The price of good land is regulated by its proximity to a good market and the facilities for transport.

It may be put at 5s. per morgen (see Table of Measures), or even less in sparsely-populated districts, and rise to £2 or more per morgen according to the locality.

The quarter- or half-share system is very generally adopted with success. Many landowners prefer to let their plots for a

rental in kind, not in money. The tenant agrees to give a quarter- or half-share of the crops as arranged, whether good or bad. On the half-share system, the proprietor usually supplies the implements, buildings, and sometimes the seeds. All these details, of course, depend on the arrangements agreed upon beforehand. In any case, it is always advisable to have a contract or agreement drawn up in the strictly legal form of the country and with the advice of disinterested persons acquainted with the matter, and not to rely on any verbal arrangement whatever; for, by neglecting to take this simple precaution, one may be left at the mercy of the owner whenever disputes occur. It is better, therefore, to have an understanding in black and white.

2. Is the ground high or low?

Only what is suitable can be cultivated.

3. Is river or spring water plentiful and close at hand, or will irrigation be necessary?

4. Is the market near or distant? what kind of transport is required and available? and will conveyance by rail or by road be best or necessary?

5. What are the difficulties to be met with and what precautions are to be taken?

6. Is the district healthy? as the choice of position to locate the homestead is an important consideration.

7. What is the composition of the soil? as it is necessary only to grow what is most suitable to it.

8. How can one obtain the cheapest Kaffir labour?

The above questions will be answered in the course of describing the following districts.

The Witwatersrand is the most important district in this section of South Africa. It is, therefore, by far the largest consumer of all kinds of produce procurable. So great is the demand for grain, vegetables, and fruit, that far outlying districts find a ready market for all products that will repay the cost of conveyance and not suffer in value during transport—such as mealies and grain of any kind, many sorts of fruits, and some vegetables.

The large and growing population in the reef country, including the adjacent market-towns of Johannesburg, Boksburg, and Krugersdorp, demonstrates that a continuous supply of every kind of agricultural product is an absolute necessity.

The rich fertile soil of the district is chiefly found in the valleys and low-lying parts, and is constantly replenished by decayed *matter* being washed down from the high lands and

ridges around. Rainwater, richly charged with valuable organic matter, in combination with the atmosphere oxidise the surfaces bathed by them; the fine particles washed from the various kinds of rocks, and mixed together before reaching the valleys below, help in forming the soft surface soil. If these accumulations are well supplied with the organisms necessary for vegetation, they form what is called a fertile soil.

The upper parts of the high ridges along the Witwatersrand are entirely dependent upon the rainy season or upon irrigation for the necessary moisture; cultivation in such parts, therefore, is not to be encouraged, as the results are of little value.

But successful cultivation is possible on both sides of the watershed, as the numerous streams and springs can be made available for a system of irrigation by means of which the fertile soil will receive the required moisture.

The soil is a mixture of clay, igneous rock, sand, and fine particles of red shale; when dry it crumbles to a fine powder, which is blown by the strong winds from the high to the lower levels, thus causing annoying dust-storms, laying bare the ground in some places, and covering it thickly with dust in others.

Trees planted for protection and mining purposes grow very rapidly. The best soils for profitable cultivation are formed on granite and dolomite rock, for these bed-rocks have a greater capacity for absorbing and holding moisture than any others. Therefore the broad dolomite and granite belt surrounding the Witwatersrand, and traversing the whole country towards Pretoria on the east and Marico on the west, may be regarded as a most promising area for agricultural development.

The natural springs and underground streams passing over such various kinds of deposits and rocks abound in the chemical or organic substances most favourable for the growth of plants. These can be identified by their colour and taste, as lime, salt, &c.

The fertile areas are readily distinguished by the luxurious and healthy growth of the wild indigenous vegetation.

The neighbourhood of the Witwatersrand is extremely rocky and hilly, so that the cultivable areas are limited to small patches of about 1 or 2 acres in extent, which are generally situated close to the streams. The altitude varies from about 4500 feet to 6000 feet above sea level. The growth of tropical plants is possible only by giving them much care and attention. This applies to all the higher land around Klerksdorp, Potchef-room, Ermelo, Carolina, and other localities. The mealies are

the principal market produce, as well as such vegetables as tomatoes, potatoes, beans, peas, cabbages, turnips, lettuces, and carrots.

The mealies should be sown early in October, as they want time for ripening before the frosts set in. Apples, plums, pears, and walnuts also grow well. Many kinds of trees have been planted along the gold-bearing belt, including Eucalyptus trees, which have grown very rapidly.

In three years time the trees are large enough to be cut up as timber for use in the mines, and there is no doubt that in the future there will be a great demand for timber.

Capitalists with foresight have recognised this most important necessity of mine timber and firewood, and have therefore invested large sums of money in laying out large plantations of useful forest trees from which they now have the satisfaction of receiving annually increasing profits.

The frosts in winter are sometimes very severe, and the Eucalyptus, black-wattle, and other trees suffer from them occasionally.

Turning to the valley lying between the Magaliesberg and Witwatersberg, through which the Crocodile river flows, we come upon wide fertile plains specially well adapted for cultivation on a large scale, where, even now, heavy crops of grain, particularly oats, are gathered every year. Yet, in spite of this very significant fact, there is still ample opportunity for further development. A prosperous career awaits the skilful and industrious husbandman. It would be difficult to exaggerate the possibilities for the future here, as many parts have not been touched by the hand of the agriculturist. This beautiful and extensive valley has a moderate altitude, being only some 3500 feet to 4500 feet above sea level. In such localities as Pretoria and Rustenburg, where the valleys are well watered and protected by the surrounding mountains, tropical plants grow pretty freely. In addition to the other kind of vegetation already referred to, the following plants are also grown :—Bananas, oranges, peaches, apricots, and citrons ; even coffee trees can in some places be ventured upon, though they are liable to be occasionally nipped by frosts. All the most useful forest trees grow profusely here, but those which are natives of a cold climate do not thrive.

Tobacco, too, is raised most successfully on both sides of the Magaliesberg. The popular weed obtained from near Rustenburg has quite a reputation for its fine quality. Many growers here, tempted by the profitable results obtained, have devoted

and deposit it wherever they can on their way to the low country. It is in this manner that the fertile condition of the soil of the plains is, in many instances, maintained from season to season. This soil is usually stratified. The lowest bed is generally a thick, clayey gravel; the middle one is sand, clay, or, in places, black soil; while the uppermost or superficial layer is in many localities a loose, black soil, chiefly composed of vegetable and animal matter.

Nearly all this region is overgrown with long grass, the roots of which have, in the course of time, been converted into a superficial black turf. In some places the water accumulates and forms swampy or marshy ground, which only needs thorough surface drainage to become most valuable and fruitful land.

There are many rich plains and slopes, well protected by steep mountains from the strong winds, most suitable for coffee planting. "Sivaso," on the east of Magatoberg, and Modjudji, east of the great Woodbush, are excellent examples of what can be done. Even two-year-old trees yield berries. The coffee is generally recognised to be of very fine quality. Great preparations are being made by interested parties for extending plantations for coffee culture on a large scale, which will add another important industry to those already established. This includes those portions of the country generally spoken of as the "North Transvaal" (from the Limpopo river southwards to Pietersburg, Hænertsburg, and Selatie). It is regarded as the prosperous district of the future. The mining centres, such as Klein Letaba, Malotopo, Houtboschberg, and Selatie, offer a great market for all produce, while the ores of the metals other than gold, which are known to exist in various places, will no doubt conduce to the rapid development of this resourceful land.

The De Kaap district, with its fertile plains, bears much resemblance to the districts previously described. As in those districts, the altitude varies from 2000 feet to 6000 feet. Although little is extensively cultivated, with the exception of mealies, the successful growth of trees, planted by people for their own pleasure, prove the suitability of the soil for most of the vegetation before-mentioned. For tobacco, the ground is particularly favourable, and there is almost unlimited space for the production of this remunerative plant. All tropical fruits mature perfectly, specimens of which can often be seen in private gardens. Experiments in coffee planting have been made, and it is found that in the De Kaap Valley, at the foot of the table-land north of Barberton, the plant flourishes extremely well. The fertile plains of this valley are somewhat

small and scattered, so that large cultivators are obliged to use several plots, which may be disadvantageously situated or inconveniently far apart. Much produce will no doubt be consumed in the future by the population gathered around the local mining industries. The railway communication with the large inland towns and sea-board makes it possible to carry out profitable undertakings.

General Features.—It is frequently remarked that the ground is poor and that nothing will grow; but this is a mistake often due to the ignorance of the planter and to his method of procedure, which is generally very primitive. Little notice is taken of the facts that—

1. In transplanting or removing plants the roots must not be injured; should they be damaged, the injured parts should be cut off with a sharp knife, so as to make the smallest wounds possible. These will eventually heal, and from them masses of small roots will develop, which will supply the food. On the other hand, if the injured parts are allowed to remain, the probability is that they will decay, and hence lead to such a weakening of the plant that it will eventually die.

2. Holes should always be dug fully large enough for the roots to be spread out to their fullest extent. The spaces between the roots should be carefully filled with earth. Plants take as their food the ultimate products of decomposed animal and vegetable matter; therefore the ground must be turned deeply over, so that the air and water can permeate the soil and oxidise its contents. The nourishment contained in the soil close to the surface soon gets used up.

3. In localities where the ground is not very fertile, the plant will soon absorb all the nutriment. Manuring is then necessary. To make successful use of manure, it should be thoroughly rotted and matured before it is applied. Fresh manure is very liable to do harm to a sensitive plant or seed. The manuring of large trees near the trunks is of no use; for the younger and finer roots alone consume the food, and these naturally spread farther each year from the centre. In watering the lands in the dry season, the usual method is to make irrigation channels gradually sloping from a spring or dam to the field under cultivation. This is traversed by smaller furrows, which should be made as level as possible, so that the water may slowly percolate downwards and not wash away any earth or seeds. The rainfalls in summer are heavier in the low lands, and yield a larger quantity of water than in the high lands. Precautions

must therefore be taken to protect the cultivated land from floods. Trenches are usually dug. To answer a double purpose, it is advisable to construct a kind of reservoir by damming a sloping valley, where the water can collect in the rainy season for use in winter. By having sufficient water, certain kinds of produce could be grown all the year round in low parts.

The methods of cultivation must differ with the nature of the soil. The fertility varies with the climate and is especially influenced by the amount of rain. Soils immediately situated upon bed-rock are sooner dried by evaporation than where the subsoil is clay.

If the soil contains much carbonate of lime or animal and vegetable matter, it then has much power to absorb water. Sand has little absorbent power.

Where the ground is clayey and holds much moisture, draining should be resorted to, for the roots cannot suck it all up, and the earth, in consequence, becomes foul or sour, thereby often destroying the fibres of the plant.

Of course, young and small plants need more attention than those that are older and larger.

When they reach a fair size they are less sensitive, for the leaves shade the ground, naturally protecting them from the occasionally too great heat in summer, so that the moisture in the soil is less evaporated. The genial heat of the soil, particularly in spring, is of the highest importance to the growing plant. Some soils absorb more heat than others. For instance, black soils containing an abundance of animal and vegetable substance are most heated by the sun and air; stiff clay, which holds much water, takes long to become warm, and then only remains so for a short time. On the other hand, clays which possess little moisture are less influenced by change of weather, and their temperature is more uniform. Hence, clay is an important ingredient of fertile soil. Soils are usually formed of silicate of alumina, silica, oxide of iron, carbonate of lime, together with animal and vegetable matter more or less converted into humus.

Difficulties which Impede the Progress of Agriculture.—1. *Locusts.*—One of the greatest difficulties with which the agriculturist in South Africa has to contend is the damage done by locusts. Various means have been employed to prevent the devastation caused by this insect, but the great uninhabited tracts of country, especially the low unhealthy fever parts which form the favourite breeding haunts, make the task of fighting

against this enemy difficult, and almost impossible. Many suggestions have been made for the needed action of individuals, but the few exterminated in populated districts will make little difference in the immensity of their number, for multiplication can continue undisturbed in vast regions where the white man has never trod.

Of course, every little helps, but unless the governments take strong measures individual endeavour will be almost useless; for the agriculturist cannot afford to use most of his valuable time in eradicating the locust outside his own sphere of interest; and, on the other hand, persons not interested in ground cultivations will trouble themselves little about their destruction.

Competent men should be officially appointed to carry out the work of extermination, and their efforts should be confined solely to allotted districts not too large for the thorough exercise of their duties. No doubt any private person would be willing to lend assistance in their neighbourhood if needed, and if called upon.

The author has met in his travels through the country, especially in the lowlands, innumerable patches of young locusts in the first stage of development. These patches of many thousands of lively hopping little insects occupy spaces from 3 feet to 6 feet only in diameter. At this period destruction is comparatively easy, for, later, they swarm together, and the marauders, now much more numerous, wander or fly far over the land, carrying devastation wherever they go.

It is, no doubt, of value to an individual person new to this country, and unaware of the habits of the locust, to know the best steps to take to prevent misfortune in the event of an approaching swarm, which, in all probability, will settle on his flourishing crops.

The two last periods of a locust's existence is the time when most damage is done. Growing dissatisfied with the limited extent of their breeding patches, they begin to march in immense numbers through the land, devouring all vegetation that comes in their path, so that cattle sometimes even starve for want of food. It is at this time they are more to be feared and more difficult to prevent from plundering than at a later stage when they are able to fly, for the measures which might be effective against the flying locusts are, in this case, of no avail.

One of the best methods to kill these wingless locusts, called locally "voetgangers" or "footwalkers," is to erect screens of slimy slippery cloth, and to dig holes in the earth at each end. Not being able to mount these obstacles they change the direc-

tion of their march, and fall into the pits at the sides where earth or water is thrown upon them. If the screens are placed well away from the cultivated land, much that is valuable will in this way be saved.

Trains have even been unable to proceed on account of the dense masses of insects collected against the rails, the slippery surfaces of which have arrested their progress. The change into the flying stage soon takes place. Great flights of them sweep across the sky, almost obscuring the light of the sun. They appear at first in the distance like small black clouds, then one or two of the foremost straggle in, generally the sign that great multitudes are advancing. On the first intimation of their approach measures should at once be taken to prevent their settling. This is usually done by raising as much smoke as possible by burning dried grass, &c., piled in heaps all round the crops and fields, arranged so that the wind, if any, blows it over the places to be protected. Noises by shouting or beating on pieces of tin are often effective in frightening a swarm away. If they once settle, the crops, trees, and grass are absolutely ruined in a very short time.

They are prevented from settling more easily in the day time than towards sunset, for they then seek a resting place for the night. Another help towards the extermination has been noticed in the last few years. It is the presence of a parasite resembling a hair worm which kills large numbers of locusts. In some localities a toxin is being used to poison or spread the disease among them, and according to reports, results have been good. The locust lays eggs in the month of November in cracked dry land or in recently ploughed low-lying agricultural soil. The eggs are deposited in bag-like capsules, about sixty in each, and are hatched in six to eight weeks. On hearing the stridulations of the male insects, the sign that the pairing season has advanced, the eggs could be collected by turning over the land on which the swarms have settled.

Two kinds of locusts have been noticed as powerful destroyers —a brown kind, *Pachytylus migratoroides* (Reiche), and a red kind, *Acridium purpuriferum* (Walk.).

2. *Hail-storms.*—They occur in every part of the country, and fall often with extreme violence, doing great damage to vegetation and animals wherever the storm happens to break. The hailstones are sometimes as large as a hen's egg. When such huge ones fall unprotected animals in the open field are frequently killed, and even galvanised iron roofs are known to have been perforated. In open fields used for grazing purposes

one should plant patches of trees under which the animals can seek shelter. The storms are very sudden, and sometimes last a long time.

3. *Drought.*—The winter or dry season is, in many highly situated plains, unfavourable for growth, as the rains run off quickly, leaving the soil dry; whereas the lands near springs, rivers, or streams are well watered, and in dry seasons are kept moist by the capillary attraction of the water from the moisture below. Of course, there are many suitable plains capable of being placed under irrigation at very trifling cost. (See *General Features.*)

APPENDIX.

WEIGHTS AND MEASURES.

TROY WEIGHT.

24 grains	=	1 pennyweight.				
480 ,,	=	20 pennyweights	=	1 ounce.		
5,760 ,,	=	240 ,,	=	12 ounces	=	1 pound.

175 pounds troy = 144 pounds avoirdupois.

AVOIRDUPOIS WEIGHT.

16 drms.	=	1 oz								
256 ,,	=	16 ozs.	=	1 lb.						
7,168 ,,	=	448 ,,	=	28 lbs.	=	1 quart.				
28,672 ,,	=	1,792 ,,	=	112 ,,	=	4 qts.	=	1 cwt.		
573,440 ,,	=	35,840 ,,	=	2,240 ,,	=	80 ,,	=	20 cwts.	=	1 ton.

1 pound avoirdupois	=	·453593 kilogramme.
1 ounce	=	28·398 grammes.
1 drachm	=	1·771846 ,,
1 ounce	=	437·5 grains.
1 pound	=	7000 ,,
1 quarter	=	2 stones.
1 American ton	=	2000 pounds.

French—

$\frac{1}{1000}$ gramme	=	1 milligramme	=	·0153 grain.	
$\frac{1}{100}$,,	=	1 centigramme	=	0·1543 ,,	
$\frac{1}{10}$,,	=	1 decigramme	=	1·543 grains.	
1 ,,	=			15·43 ,,	
10 grammes	=	1 decagramme	=	154·3 ,,	
100 ,,	=	1 hectogramme	=	1,543 ,,	3·2150 ozs. Troy or 3·5291 ,, Avoir.
1,000 ,,	=	1 kilogramme	=	32¼ ounces.	
10,000 ,,	=	1 myriagramme	=	22·046 lbs.	

MEASURES OF CAPACITY.

1 scruple	=	20 grains or minims.
1 fluid drachm	=	60 minims.
1 fluid ounce	=	8 fluid drachms.
1 pint	=	20 fluid ounces.
1 gallon	=	8 pints.

LIQUID MEASURE.

1 gallon	=	0·16046 cubic foot.
1 cubic foot	=	6·2355 gallons.

MEASURES OF LENGTH.

12 ins.	= 1 ft.					
36 ,,	= 3 ,,	= 1 yd.				
188 ,,	= $16\frac{1}{2}$,,	= $5\frac{1}{2}$ yds.	= 1 pole.			
792 ,,	= 66 ,,	= 22 ,,	= 4 poles	= 1 ch.	= 100 links.	
7,920 ,,	= 660 ,,	= 220 ,,	= 40 ,,	= 10 chs.	= 1 furlong.	
63,360 ,,	= 5,280 ,,	= 1,760 ,,	= 320 ,,	= 80 ,,	= 8 fur.	= 1 mile.

1 inch	= 2·539954 centimetres	=	1 metre	= 3·2809 feet.
1 yard	= 0·9143835 metre	=	1 ,,	= 39·3708 inches.
1 mile	= 1·6093149 kilometres.			

1 knot or geogr. mile = 6082·66 feet = 1,854 metres = 1·152 statute miles.

French—

1 millimetre $\left(\frac{1}{1000}\text{ of a metre}\right)$ = ·03937 inch.

1 centimetre $\left(\frac{1}{100}\text{ ,, }\right)$ = ·3937 ,,

1 decimetre $\left(\frac{1}{10}\text{ ,, }\right)$ = 3·937 inches.

10 metres	= 1 decametre	= 32·809	feet or 10·9363 yards.
100 ,,	= 1 hectometre	= 109·3633	yards.
1,000 ,,	= 1 kilometre	= 1093·63	,, or ·62138 mile.
10,000 ,,	= 1 myriametre	= 6·2138	miles.

SQUARE MEASURE.

144 square inches	=	1 square foot.
1,296 ,, ,,	=	9 square feet = 1 square yard.
39,204 ,, ,,	=	272¼ ,, ,, = 30¼ sq. yds. = 1 perch.
1,568,160 ,, ,,	=	10,890 square feet = 1,210 square yards = 40 perches = 1 rood.
6,272,640 ,, ,,	=	43,560 square feet = 4,840 square yards = 160 perches = 4 roods = 1 acre.

1 morgen = 2·117 English acres.
1 acre = 10 square chains.
1 acre = 4,046 square metres.
1 square mile = 3,097,600 square yards = 640 acres.

French—

1 hectare = 2·471143 acres or 11960·33 sq. yds. or 27,878,400 sq. feet.
1 are = ·0274 acre or 119·6033 square yards.
10 ares = 1 decare = ·2474 acre or 1196·033 square yards.

ABBREVIATIONS.

1 minim,	*min.*	1 gallon,	*gall.*
1 grain,	*gr.*	1 quarter,	*qr.*
1 pennyweight,	*dwt.*	1 hundredweight,	*cwt.*
1 ounce,	*oz.*	1 inch,	*in.*
1 pound,	*lb.*	1 foot,	*ft.*
1 drachm,	*drm.*	1 cubic foot,	*cub. ft.*
1 fluid drachm,	*fl. drm.*	yards,	*yds.*
1 fluid ounce,	*fl. oz.*	square,	*sq.*
1 pint,	*pt.*		

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